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Manufacture of Special Devices

At certain of the mechanical association conventions during the past year statements have been made to the effect that the foremen are often handicapped in the making of special devices and improvements to the machine tools by the lack of proper co-operation of the foremen in the other trades, whose aid had been solicited in making the different parts of the device. This, of course, is to be regretted, especially at this time when economy in shop production means so much to the railroads. Every foreman should seek to better the service whether the results of his labors will reflect directly to his credit or not, and the broad-minded foreman will do this. Perhaps the requesting foreman is at fault in asking his brother foreman to do something that is not covered by the proper shop order—something "on the side," as it were. The best method is to submit the plan of the proposed improvement to the general foreman, master mechanic, or superintendent of shops, as the case may be, and have the order for the work sent to the various other shops through the regular channels. By doing this no favors are asked, and there is some one in authority to see that the work is properly and quickly done. If the device is worth anything it is worth the consideration of the men who have direct charge of the shops involved in its manufacture, and it is to their interest, as well as the foreman making the request, to see that it is finished and placed in service as soon as possible. In other words, it is a matter of business, not of personal favor.

European Vestibule Connections

Elsewhere in this issue will be found a description of a covered passageway for use between passenger coaches, which is in service in Switzerland. Because of the space between the ends of the cars it is necessary to have a device that can be folded or extended for a considerable distance, and the bellows extension has been in general use for this purpose. Owing, however, to the length of extension which is necessary, this folding bellows consists of many more folds than the comparatively short device which is used on vestibuled cars in America. The necessity of folding and unfolding requires that the folds be kept free from cinders, snow and ice and it can be readily seen that this must be a difficult task; in fact, it is stated that a great deal of time is lost in clearing out the folds and in some cases it becomes impossible to close the extension at all. The improved arrangement consists of three frames with flexible connections, the frames being made of such sizes that they will fold together when not in use, the outer frame forming a pocket around the other two and their flexible connections. When extended and in use between cars the surface presented is comparatively smooth and there is little or no opportunity for the collection of cinders or snow. While it is claimed that this improved device is working out quite satisfactorily, neither the new

nor the old type is likely to appeal very much to American railroad men. Neither the connections themselves nor the adjustable platforms which are employed with them give the impression of strength and neatness of appearance inherent in the end construction of American passenger cars.

Efficiency of the Mikado Type Locomotive

Within the past three years the number of Mikado type locomotives in service in this country has increased greatly. On June 30, 1911, the Interstate Commerce Commission reported 652 of these locomotives in service. This number was nearly doubled by those ordered in the calendar year 1911, the number being 590. In 1912 there were 1,309 ordered and in 1913 there were 796 ordered. This would make approximately 3,000 Mikado locomotives in service on June 30, 1914, or an increase of about 460 per cent in three years. That this increase has been warranted is shown by tests made by various roads. Comparing the Mikado type with the Consolidation locomotive, the Chicago, Rock Island & Pacific has found that the average consumption of coal per 1,000 gross ton miles is 66 lb. for the Mikado as against 96 lb. for the Consolidation, or a decrease of 31 per cent in favor of the Mikado. Dynamometer car tests on the Chicago & North Western have shown a decrease of 18.7 per cent in fuel consumption per 1,000 gross ton miles (excluding resistance of locomotives) in favor of the Mikado. The Chicago Great Western has shown a saving of 36.8 per cent for the Mikado, the comparison being made from figures obtained from the service rendered by 10 engines of each of the different types for 12 consecutive months. In all three cases the Mikado locomotives were equipped with superheaters, but in only one case were the Consolidation engines thus equipped. That case was on the North Western, and this fact accounts for the difference in fuel economy on this road as compared with the other two roads. This does not mean that every Consolidation engine should be replaced by a Mikado, for there are occasions where the Consolidation locomotives can be used to better advantage. It does mean, however, that the Mikado type locomotive can replace the Consolidation locomotives with a marked saving in fuel economy in many instances, especially in through and fast freight service.

Will the Compound Locomotive Be Revived?

One of the contributing causes—and by a great many it is held to be the main cause—of the downfall of the compound locomotive was the difficulty and expense of the upkeep. It was not extremely difficult to keep a compound in such shape that it could be gotten over the road; but in most cases it proved very difficult and expensive to keep this type of locomotive in such shape as to obtain the advantages of compounding. Instead of the hoped for and prophesied advantages of the compound over the simple locomotive being realized, there were actually disadvantages. The trying out of the principles of compounding in American locomotive practice took place at a time when anything tending toward the increasing of the complexity of the locomotive was frowned upon; since that time conditions have changed. The complexity of the air brake system has increased threefold; the superheater has come into general use; the mechanical stoker has entered and passed the experimental stage and the compound itself has added its quota in the Mallet type. By adding to the amount of machinery about a locomotive these items have also added to the care and attention needed to keep it in proper operating condition. The superheater has been the cause of wonderful improvement in the economy of moving traffic, but there will still be calls for further economy when the superheater has reached its limit. The question then arises, what lines will the future development of the steam locomotive follow? Much has been accomplished recently toward increasing horsepower and at the same time decreasing the weight per horsepower developed. American practice has been tending more and more toward refined lines and in that way, in some respects at least, has been tending more toward the ideas which obtain in Europe. The compound locomotive has met with considerable success on European railways and with the change in attitude which has taken place in this country during recent years toward increasing the amount of machinery on a locomotive, experiments embodying the use of compounding principles in connection with the superheater and the brick arch, while entirely a matter of speculation, would not seem to be unlikely.

The Training of Foremen

It has on occasion been remarked, and by men whose opinions in such matters should carry weight, that in order to be a successful executive one must be born with executive ability. We venture to disagree with this statement, while granting that the born executive is likely to prove more successful in the long run than one whose executive ability is the result of training and experience only. A case in point is that of a certain engine house foreman. The division master mechanic had never been able to obtain a foreman who could make a success at one of the smaller terminals. There were a number of reasons for this, including bad labor conditions. After several unsuccessful appointments a young man, then a machinist, was chosen as foreman and sent to this point to "clean it up," as the master mechanic expressed it. He made a dismal failure and had to return to work in the shop. Instead of giving him up as a bad job the master mechanic believed that he himself was at fault in starting the man in on a job that was too heavy for him, and a few months later the young man was given an opportunity to show what he could do as an assistant foreman. He filled this position most successfully for some time and succeeded to the foreman's position, but when left thus to his own resources and without the guidance of a foreman over him, he again went to pieces. He was again given an appointment as assistant foreman, and after another two years in this position was promoted to foreman. The experience of being twice set back had taught him his lesson and he is now one of the most successful foremen on this road.

We do not mean to claim that if every man who has failed to make a successful foreman had been treated in this way he would now be holding an executive position; there are men who will never make successful foremen under any circumstances. But this master mechanic had studied the young man. He was disappointed in the results of the first appointment, not so much in the young man as in himself for not using better judgment. He talked to him encouragingly and was not afraid on two occasions to give him another chance; indeed if he had failed the third time it is quite probable that he would still have had another opportunity to make good. We are quite aware that much experimenting of this kind would probably be expensive for a railway; but in this case the experimenting was justified by the results that have since been obtained. This man has for several years been in charge of a large roundhouse and has saved for the company much more than was expended or lost in his education. Moreover, he is now one of the principal members in a loyal, harmonious working force, an asset whose value cannot be computed.

There are many railway officers who, if a man fails in the first position to which he is appointed, give him up entirely as a bad job. No one would think of discharging an apprentice a month after he had entered on his apprenticeship course because he was unable to do a journeyman's work. Is it unreasonable to consider a man who is taken from the ranks and placed in charge of repairing cars and locomotives as a student of the art of directing men? Such a man, unless he be a born executive, is just as much an apprentice as he would be if he were starting in to learn his trade as a boilermaker or ma-

chinist; but it is ten to one that he will be placed in an out of the way terminal and left to his own resources. Aside from a brief talk by the master mechanic before he leaves for his new position he receives no assistance, and it may be weeks or even months before he receives a visit from his superior officer, and his correspondence will contain a large percentage of rebukes or requests to "please explain." Under such conditions, unless a man be a born executive and be possessed of more than the average amount of sand, there is no reason why he should succeed, and almost every reason why he should fail. The duty of the mechanical department officer towards a foreman should not end in his careful selection and appointment. In placing him in a foreman's position he has placed him in the position of a learner in the art of directing railroad work, and it is his duty to stand by him and assist him in every way possible in his study of men and conditions. The newly appointed foreman may be the master mechanic or superintendent of motive or master car builder of the future and his ability to fill such a position may depend, and in the majority of cases we believe it will depend, largely on the assistance given him during his early training as a foreman.

The master mechanic in the specific instance cited blamed himself more for the failure of the man than he did the man himself. He placed the man in an extremely difficult position; he did no go to the terminal with him, nor introduce him to any of the men with whom he would come in contact; he simply put the situation up to him and left him alone to do, or die. If the young man had had a guiding hand at that terminal during the first few weeks or even days he would probably have made good. The reasoning that a man should not receive assistance and coaching after he is appointed to the position of foreman, because the great majority of foremen have made good without such coaching, does not constitute an argument; if the thousands of men who have failed as foremen had received such guidance and instruction a large percentage of the failures would have been prevented.

Shop Facilities and Labor

During the past few years much attention has been given to scientific management. A great deal has been written from which it might appear that the human element was the prime factor in the problem. As a result there are a number of piece-work and bonus systems in operation, all designed to increase the output of labor by speeding up the individual. None of these, however, has succeeded in eliminating the uncertainty attaching to the human element. It is of interest in this connection to note what has been accomplished in a manufacturing establishment, the management of which has been working along entirely different lines. In the already well-managed plant of the Ford Motor Company, the labor time consumed in assembling each chassis was reduced from 12 hr. 28 min. to 1 hr. 33 min. by a campaign of improvement in shop facilities extending over a period of about seven months; and in accomplishing this result the effect of the labor element upon the output of the shop has been practically eliminated. The rate at which the completed cars are turned out is determined by the speed of an endless chain conveyor along which the chassis moves as it is assembled. Of course, such results are only obtainable in a plant of this kind where a uniform product is turned out, and the application of such methods to the average railroad shop would be extremely limited in scope. The fact should not be lost sight of, however, that the output of labor depends as largely on shop facilities as on the efforts of the individual. The economies often effected by slight changes in the arrangement of machine tools or by the adoption of special tools for certain classes of work are well understood. But the question of shop and inter-shop transportation is one of special importance, which has not been given the attention it deserves. The amount of labor expended in moving material, as it passes through the shop or from the yard to the shop, where the machine tools and buildings are poorly grouped, is often surprisingly high. It is true that in modern shop layouts much has been done toward increasing efficiency in this regard, but material transportation in and about the railway shop is still largely carried on by hand. The more flexible power transportation facilities, such as the monorail hoist and the storage battery truck, are finding considerable application in industrial plants and there is no reason why they should not be of great value in railway shops, especially where an ideal plant layout is impossible.

NEW BOOKS

Proceedings of the International Railway General Foremen's Association. Compiled and published by William Hall, secretary-treasurer of the Association, Winona, Minn. 193 pages, 6 in. by 9 in. Bound in paper.

The tenth annual convention of the International Railway General Foremen's Association was held at the Hotel Sherman, Chicago, on July 14, 15, 16 and 17, 1914. This book contains the complete report of the proceedings, including committee reports, papers and discussions. The association is to be congratulated upon the shortness of the time which has elapsed between the closing of the convention and the publication of the proceedings.

Car Interchange Manual. Compiled by J. D. McAlpine. 150 pages, 6 in. by 9 in. Bound in paper. Published by J. D. McAlpine, Cleveland, Ohio. Price 50 cents; $4.50 per dozen.

This publication has been issued with a view of giving railway employees interested in the interchange and repair of cars, a condensed report of the decision of the Arbitration Committee of the Master Car Builders' Association from case one, rendered in November, 1888, to case 966 rendered in July, 1914. Those cases that are relatively unimportant are either omitted or abstracted without losing the meaning of the decision. There is included as a supplement to this book the Car Interchange Guide and Ready Reference Tables. This includes various prices of new and second hand material, such as couplers, wheels, axles, journal bearings, etc., together with the weight and the labor involved in installing the various detailed parts. A table of the value of wooden freight cars of different lengths is also included, as are tables of depreciation at various percentages. The M. C. B. rules are included, being grouped under various headings, such as air brakes, draft timbers, wheels and axles, improper repairs, etc. The arbitration decisions that affect each topic are also mentioned under these headings. The Car Interchange Guide and Ready Reference Tables is also published separately, the price being 35 cents, or $3.50 per dozen copies.

Experiments with Furnaces for a Hand-Fired Tubular Boiler. By Samuel B. Flagg, George C. Cook and Forrest E. Woodman. Technical paper 34, Department of the Interior, Bureau of Mines. 32 pages, 6 in. by 9 in., illustrated. Bound in paper. Published by the Bureau of Mines, Washington, D. C. Copies free.

In the course of its investigation looking to increased efficiency in the utilization of fuels by the government, the Bureau of Mines has given special attention to the elimination of objectionable smoke from burning coals containing much volatile matter, such as are most readily available in many cities. With the increasing use of mechanical stokers at large boiler plants the problem of smoke abatement is becoming more and more that of assuring smokeless combustion with the hand-fired return tubular boilers commonly found at small plants. Six series of tests were conducted with a small horizontal return tubular boiler, in which several types of furnace arrangement were used. As a result of these tests several general conclusions, as well as others of more restricted application, have been drawn. The experiments indicate the possibility of designing hand-fired furnaces in which coal containing a large amount of volatile matter may

be burned without the production of objectionable smoke. More attention to the method of firing is required, however, than is given by the average fireman.

Railway Fuel Association Proceedings. 342 pages, illustrated, 6 in. by 9 in. Bound in morocco. Published by the association, C. G. Hall, Secretary, 922 McCormick building, Chicago. Price $1; paper binding, 50 cents.

This book is the official proceedings of the sixth annual convention of the International Railway Fuel Association held in Chicago, May 18-21, 1914. It contains a very interesting address by Dr. W. F. M. Goss, reports of committees on Fuel Tests, Firing Practice and Fuel Stations. Also papers on Honeycomb and Clinker Formation, The Relation of Front End Design and Air Openings of Grates and Ash-pans to Fuel Consumption and Sparks, Uniform Methods of Computing Fuel Consumption, Sizing of Coal for Locomotive Use, Storage of Coal, Morden Locomotive Coaling Station, Reheating Locomotive Boiler Feed Water, Fuel and Failures, and Economies in Roundhouse and Terminal Fuel Consumption. These proceedings contain valuable information on the subjects above mentioned and may be considered authoritative in questions pertaining to fuel economy on railroads.

Power and Power Transmission. By E. W. Kerr, M.E., professor of mechanical engineering, Louisiana State University. Third Edition, revised. 373 pages, 6 in. by 9 in., illustrated. Bound in cloth. Published by John Wiley & Sons, Inc., New York. Price $2.

The first edition of this book was published in 1901 and the second in 1907. It has now been revised and contains 24 more pages of matter and 61 more illustrations than the previous edition. The book is divided into three parts. Part 1, which deals with machinery and mechanics, contains an introductory chapter dealing with definitions, terms, etc., and the other chapters in this section consider such subjects as shafting, bearings, friction and lubrication, friction wheels, pulleys, belt gears, toothed wheels, the screw, cams, the lever and some of its modifications, link work and pipe fittings. Part 2 is devoted to steam power with chapters dealing with elementary steam power plants, the simple steam engine, automatic cut-off engines and high speed engines, indicators, compound engines, condensers, valves and valve gears, valve diagrams and rotary engines and steam turbines. Part 3 is devoted to pumping machinery, internal combustion engines, water power and compressed air.

Administration of Labor Laws and Factory Inspection in Europe. Bulletin No. 142, Department of Labor, Bureau of Labor Statistics, Washington, D. C. Bound in paper.

Recognition of the fact that the administration and enforcement of labor laws involve much more than a mere system of detecting violations of law is becoming more and more apparent. The establishment of definite rules and standards for the safety and health of workers, higher specialization of the functions of inspectors, and the creation in a number of states of industrial commissions with large powers are indications of the progress made. In view of the attention the subject is receiving in our own country the experience of foreign countries in the administration of labor laws and factory inspection is of interest. This bulletin is a report on the development and present status of factory inspection in Great Britain, Germany, France, Austria, Switzerland and Belgium, and shows that little progress in scientific standardization of safety and sanitation has been made in Europe. Inspection to detect violations of law is still the method used by most inspectors and most European inspection departments are far behind the more progressive departments in the United States in the matter of keeping records of inspections, violations of the law, etc.

COMMUNICATIONS

STANDARDIZING SHOP PRACTICES

Waycross, Ga., September 14, 1914.

To the Editor:

In locomotive repair work it is important that the most economical practices consistent with turning out good work be used. On railroads having several shop organizations it is very often the case that each shop management has its own ideas and methods of doing certain operations, some of which are very good and others of which are very expensive. I believe it would be a paying proposition to appoint a practical mechanic to tour the entire system, visiting the various shops and studying the methods employed in making repairs and turning out work at each point. Considerable saving could be effected in this way by putting the best methods into general practice and eliminating local practices of a doubtful character.

There are other ways in which the services of such a man would prove of value. From time to time there are many instructions issued relative to changes in standards and making betterments of various kinds which are not always fully understood by all concerned, and much confusion and unnecessary expense often result. A man in the position referred to would be able to see that such instructions were correctly interpreted and carried out as intended.

H. C. Spicer,
Gang Foreman, Atlantic Coast Line.

MELTED BOILER TUBES

Columbus, Ohio.

To the Editor:

I have read the article in your August number relative to melted boiler tubes. A number of years ago I was roundhouse foreman of a large terminal and passed through two experiences of a similar nature.

The first resulted in the destruction of the flues and flue sheets, similar to the experience of X. Y. Z., it being necessary to cut the flues out in sections to remove them from the boiler. The cause was similar also, the engine having been damaged in the yard and brought into the house during the latter part of the night, at which time the roundhouse foreman discovered the presence of excessive heat; it required considerable time to stop combustion.

A few months later an engine was fired up about 1 p. m., after having been washed out without being refilled with water. Apparently a very good fire had been started before the trouble was discovered. The fire was immediately drenched in the firebox and all openings closed with the expectation that no further damage would be done. However, the engine was found to be generating excessive heat similar to the first engine referred to, and arrangements were at once made to place steam jets in the firebox through the ashpan. This steam was applied through the openings for from 12 to 15 hours before the engine showed evidence of cooling down; with the exception of a going over of the flues no further damage was done.

This may be of interest to those who may have a similar experience, and is a simple way of overcoming the trouble. Neither of these engines was equipped with a brick arch.

M. A. Kinney,
Superintendent Motive Power, Hocking Valley.

The Submarine Vessel.—The experiment with this machine will take place at St. Ouen, as proposed. The vessel was repeatedly sunk to the depth of 10 or 12 ft., and re-appeared on the surface at different points. M. Godde de Laincourt got into it, and remained there a quarter of an hour. He stated that he did not experience the least difficulty of respiration during his voyage under water.—*From American Railroad Journal, October* 24, 1835.

BOSTON AND MAINE REPAIR SHOPS

Analysis of Conditions Leading to the Construction of the Billerica Plant, With a Description

BY F. K. IRWIN

The need for new general repair shops on the Boston & Maine may be easily seen from a brief study of conditions and facilities existing prior to taking up the building and equipping of the plant at North Billerica, Mass.

In 1907 the Boston & Maine owned 1,100 locomotives, which on a basis of 80 per cent repaired per annum meant a monthly shop output of 73.3 locomotives. The figure of 80 per cent repaired per annum has been selected as a basis of requirements, as it permits repairs to all engines once in 15 months, and has been found to be good general practice. It is not advanced as a hard and fast rule, but as a fair basis for estimating.

To take care of this equipment the Boston & Maine had the following facilities:

Boston shops	.....	15 locomotives per month, Class 3 and 4 repairs.
Lyndonville shops	.....	5 locomotives per month, Class 3 and 4 repairs.
Keene shops	.....	17 locomotives per month, Class 3 and 4 repairs.
Concord shops	.....	25 locomotives per month, Class 2, 3 and 4 repairs.
Total	.....	62 locomotives per month, Class 2, 3 and 4 repairs.

There were no facilities for firebox and general boiler work and while Concord was rated as a class 2, 3 and 4 shop, this was the shop to which locomotives were sent for stripping the boilers for shipment to contract shops and where they were reassembled on return; all firebox and heavy boiler work was, of necessity, done at some contract shop.

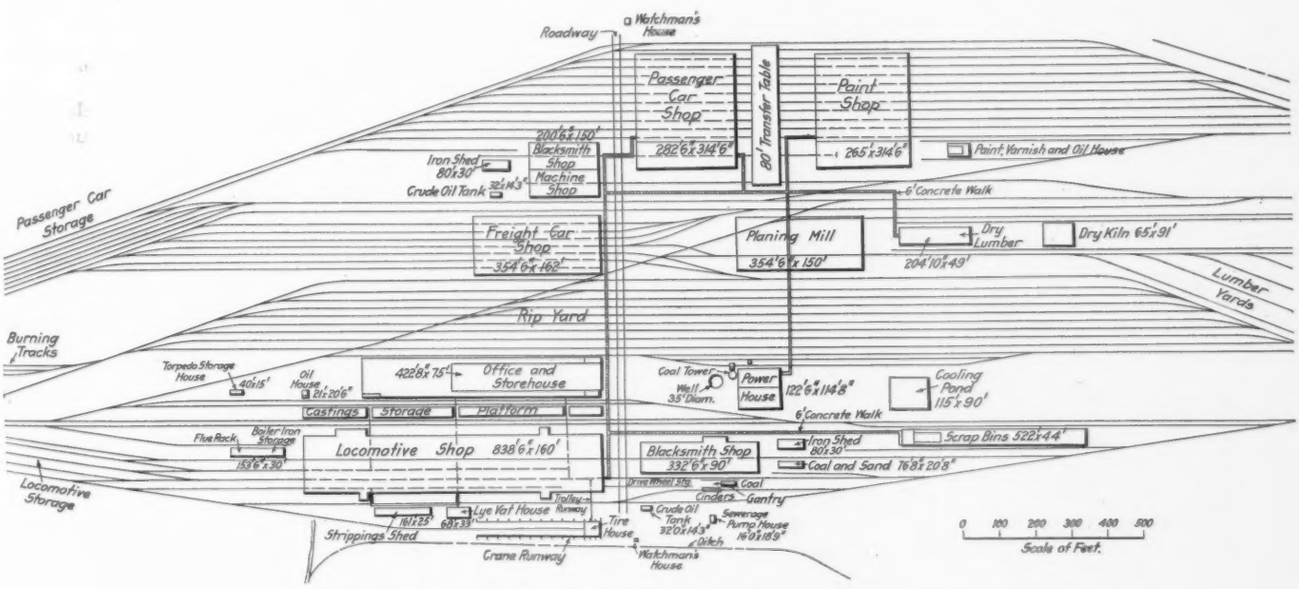
The Boston shops were destroyed by fire December 5, 1907, badly crippling the railroad in so far as repairs to equipment were concerned. Orders were given to develop plans for a general shop, to include, not only locomotive, but passenger and freight car repairs, the car situation being just as serious as the locomotive. The site selected was East Somerville, on a piece of property owned by the railroad, located on the Mystic river and contiguous to the main line tracks.

Small progress was made in actual development; a general layout plan was made and a building erected approximately 250 ft. long, containing ten repair pits and two low machinery bays. This building was equipped with traveling cranes and such machinery as was necessary to care for immediate needs in the line of class three repairs, which in general constitute repairs to driving wheels, running gear, valve motion, and general machinery; there were no blacksmith or boiler facilities. The intent was to make this a nucleus for the main shop for the system.

The work of carrying out the plans, as far as developed for East Somerville, proved to be a slow process. In consequence the Boston & Maine employed a special engineer in 1910 with a corps of draftsmen and field engineers, whose exclusive duty was to work out the shop problem. One of the first decisions reached was to abandon further development at East Somerville for several reasons.

First, the ground was too congested to permit of future extension; the plans as worked out were very complete, in fact too complete, taking care of present needs but not allowing for expansion. The necessity for the constant use of a transfer table and a one entrance shop yard were, in themselves, not ideal conditions.

Second, anticipated electrification within a radius of 25 miles of Boston, made the location geographically poor from a steam locomotive standpoint, as all steam power would be kept in service outside of the electric zone.



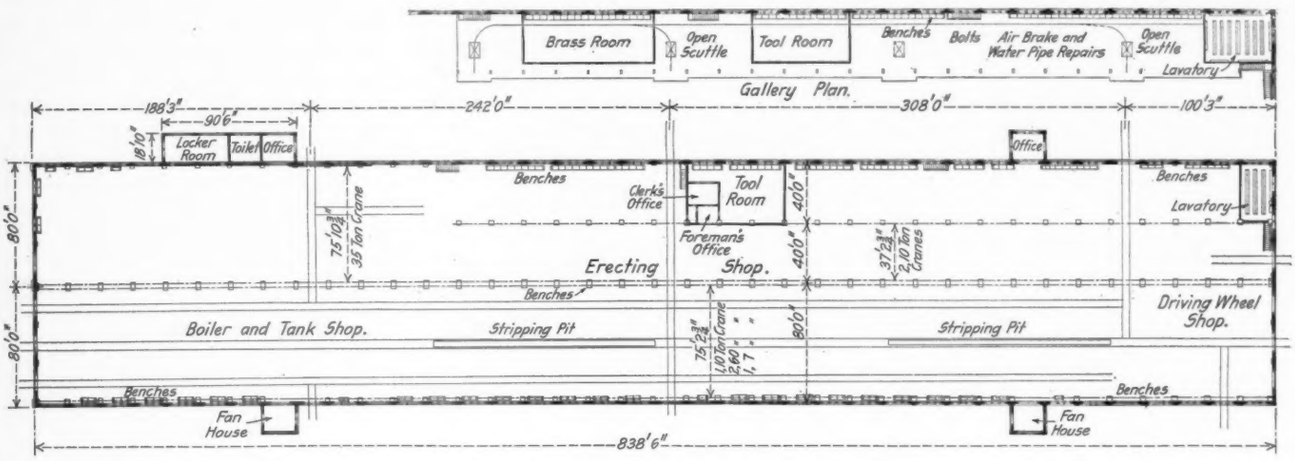
Plan Showing Yard Tracks and Grouping of the Buildings at the Billerica Shops

Third, the East Somerville shop, as far as built, was considered excellent as to capacity, location, and equipment for a repair shop for electric locomotives and other equipment.

A shop site committee was appointed by Frank Barr, vice-president and general manager, consisting of Henry Bartlett, mechanical superintendent; A. S. Cheever, division superintendent; C. B. Smith, mechanical engineer, and F. K. Irwin, special engineer. This committee, after spending months in canvassing sites offered, finally decided to recommend the purchase of the property located at North Billerica. This site offered many advantages, among which may be mentioned ample area, least preparation of ground for buildings, accessibility, nearness to a labor market, being four miles from Lowell and near a trolley line; and situated as it is between the main line of the Southern division and the Bedford and Billerica branch, which form a

junction near North Billerica station, a shop approach was permissible from either end of the shop yard. The main shop track, 8,000 ft. long, completes the third side of a wye.

The field party under the direct supervision of S. P. Coffin, who was assistant engineer to the special engineer, began surveys for preparation of deed maps and topographical maps February 10, 1911, and the actual work of repairing locomotives



Plan Showing Arrangement of the Locomotive Shop

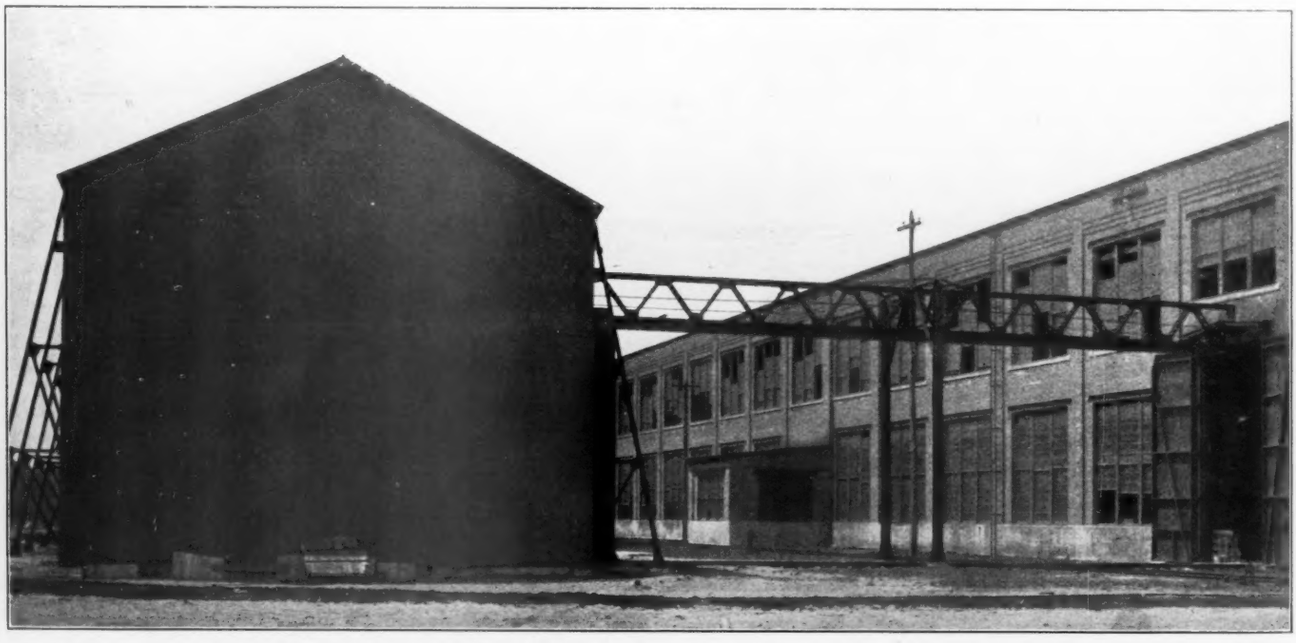
was begun February 9, 1914, three years from the time actual field work began.

The acquisition about that time of control of the Boston & Maine by the New York, New Haven & Hartford introduced a new feature in the problems to be solved and it was determined to co-ordinate or combine the shop facilities of the various roads making up the New England Lines. A careful study and exhaustive report on the shop situation was made by A. B. Corthell, chief engineer. The essential features of this report being as follows:

Number of locomotives on Boston & Maine in 1911	1,261
Average annual increase for 5 years	77
Average taken out of service for 5 years	36
Net annual increase	41
Anticipated ownership, 1913	1,343
Shop output per month on Boston & Maine	90

The Maine Central had approximately 240 locomotives and would require an output of 16 per month on the same basis of overhauling each engine once in 15 months; this increased the shop requirements for both roads to 106 locomotives per month. It was estimated that possible electric operation would release 89 engines of all classes for use outside the electric zone. This was considered a decrease in steam locomotive shop requirements of six per month. The record of repairs passing through the shops indicated one-third first and second class repairs, necessitating firebox and heavy boiler work and extraordinary machinery repairs; two-thirds, third class repairs; leaving class four and five repairs to be taken care of at roundhouses.

On the Boston & Maine there were 2,100 passenger cars, including those on order. On account of the constant use of cars it was necessary to provide shop capacity to put the whole equipment through for all classes of repairs in seven months, or 300 per month. To avoid an accumulation of bad order freight cars it was deemed necessary to provide for 2,300 cars per month.



Tire Setting House and Monorail Hoist Runway from the Tire House to the Locomotive Shop

The following tabulation showed the then and anticipated output per month of Boston & Maine equipment, and the Billerica shops requirements to balance the work. This does not take into

consideration the possible release of locomotives by electric operation:

Shop Location	Locomotives		Passenger Cars		Freight Cars	
	Present	Proposed	Present	Proposed	Present	Proposed
Lyndonville	5	7	8	10	92	100
Keene	15	15	..	..	..	..
Concord	29	26	35	35	330	330
Fitchburg	..	..	80	..	560	1,500
Readville	3	5	..	..	..	..
Waterville	6	8	..	..	..	..
Portland	8	8	..	..	..	..
E. Somerville	9	8	..	..	..	..
Mystic Wharf	..	..	..	..	320	320
Total	75	77	123	45	1,302	2,250
Requirements	..	106	..	300	..	2,300
Billerica	..	29	..	255	..	50

From the above it was recommended that provision be made at Billerica for standing room for 20 locomotives in order to easily make first and second class repairs on 30 per month, depending on the Readville shops of the New Haven to take care of five class one and two. This being one-third the total requirements, and these two shops being the only ones equipped for firebox work, it was decided to send class three and four repairs to the other shops. The passenger car requirements for Billerica being 255 cars per month it was decided to provide shop capacity for 180 cars and take care of 75 light repairs in the passenger car yard. Freight car repairs were to be made at Fitchburg, making this a freight shop only. Space has, however, been alloted at the Billerica shop site for both a mill and freight shop. The question of steel cars will have to be provided for in the near future and these two buildings will then be designed to meet steel car conditions. Repair tracks for taking care of running freight repairs have, however, been laid.

The general layout was made with a view towards keeping such buildings and branches of the work as are interelated as conveniently located with reference to each other as possible and also so that future extension would not be interfered with. An examination of the general plan shows how each building may be extended without interfering with any of the others.

The repair yard tracks were located between what may be called the locomotive group and car group for two reasons; first, to have them as near the storehouse as possible as the repair yard is a heavy customer of the stores department; second, in order to get as long level tracks as possible at this location; and finally not to block the extension of the passenger car and paint shops. Had these tracks been placed west of the passenger car shops, the length would have been materially shortened, the transportation of mounted wheels would have become a serious problem, and the passenger car shops would have been blocked unless heavy work was done in the future to relocate the repair tracks.

As a matter of convenience in this description, the shop plan will be considered as lying north and south, with the top of the map west.

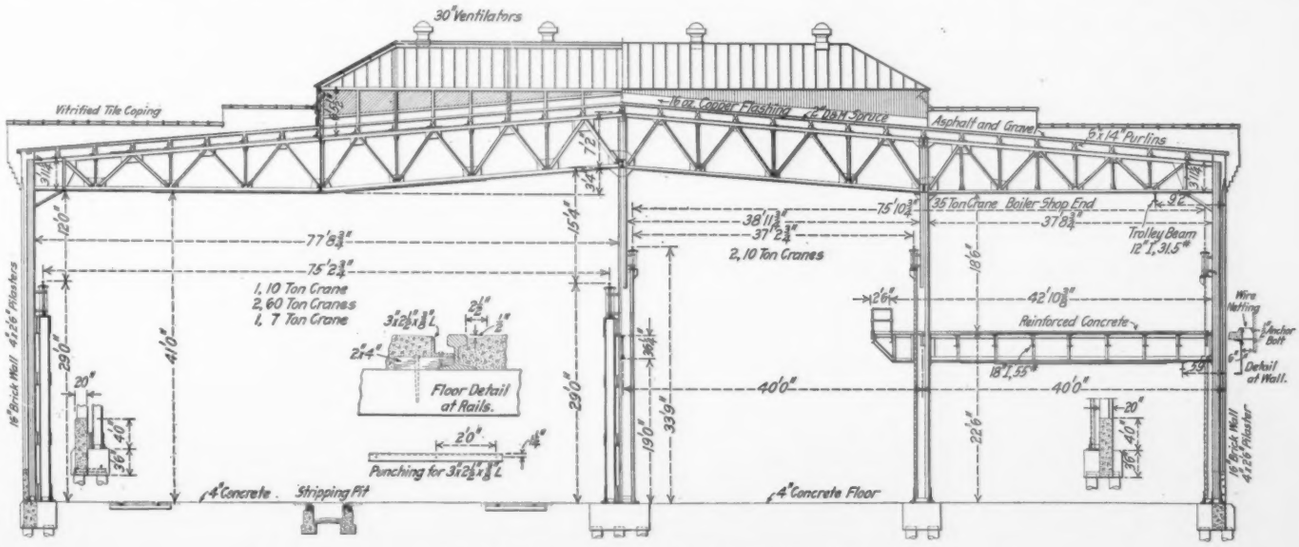
All buildings rest on concrete piles and with the exception of the office and storehouse are steel frame, with brick curtain walls and mill construction board roofs, with Barrett Specification gravel roof covering and the National Skylight & Ventilator Company's skylights. The office and storehouse rests on concrete piles and is of slow burning timber construction with mill construction roof. All auxiliary buildings are frame, designedly so, in order that they may easily be moved in the event of extending the main buildings.

GENERAL PLAN

East of the main shop is the stripping shed, divided into 20 stalls for the storage of pipe, fittings, and other strippings from the locomotives, until they are needed again. Directly opposite the center door on the east side is the lye cleaning house, a brick building with two concrete tanks or pools 10 ft. by 20 ft. by 6 ft. 6 in. deep. The tanks and floor of the cleaning house are served by a pneumatic crane of five tons capacity, spanning the full width of the house and traveling the full length.

Next in order is the tire house, a steel frame building with corrugated iron sides and roof. This house is equipped with an oil furnace capable of heating eight tires at once, facilities for removing and putting on tires, an electric traveling crane bridge, 40 ft. span, with underhung single I-beam trolley, 7 tons capacity. Extending southerly from the tire house is a crane runway. The space within the runway area is for storing tires, wheel centers, axles, etc. A standard gage track extends through the length of the runway space. The operator in the trolley cage controls the movement of the crane bridge, trolley and a similar crane bridge in the north end of the locomotive shop. Material may be handled from cars to storage by means of this trolley, from storage into the tire house or into the locomotive shop, there being an I-beam runway between the tire house and the locomotive shop. The crane bridges having been properly lined and locked with this I-beam, the operator moves from one bridge to the I-beam runway thence to the other bridge, which he can then move up and down the shop at will, the bridge motor controller being in the trolley cab.

Dividing the shop grounds is a main thoroughfare 100 ft. wide running east and west. On the north line of this street and opposite the end of the locomotive shop are the blacksmith and



Cross Sections Through the Locomotive Shop

hammer shop, blacksmith iron shed and sand and coal storage. Coal and ash handling for locomotives and refuse from the blacksmith shop are taken care of by a traveling gantry crane with overhanging ends, fitted with a grab bucket. Coal is unloaded from the tenders into a bin. Ashes are deposited in a pit and handled to cars with the same outfit.

All scrap is under the control of the general stores department, and the scrap platform has been located for their convenience in handling, also for convenience in disposing of scrap from the repair yards and locomotive department.

The general store and office building is west of the locomotive shop. This building is provided with liberal platform space on the sides and at the south end, the main floor being 4 ft. from top of rail for convenience in unloading and loading cars. This is the general store for the system.

The power house is located in a line north of the storehouse room having been left for extension and also for storage of coal. South of the power house is a storage well of 100,000 gal. capacity. There are also eight 3-in. driven wells west of the power house. The elevated coal bunker is of 125 tons capacity, and is served with a skip hoist. The cooling pond is north of the power house.

The repair yard will have nine tracks with an average level length of 2,300 ft. each; five have been laid. These tracks are on 22 ft. centers, giving ample space for material and for working between the cars.

The car group of buildings occupies the westerly half of the property; beginning at the south end storage tracks for both passenger and freight cars and burning tracks have been provided. Space has been left for a freight repair shop planing mill as indicated. The dry lumber shed and dry kiln come next in order and then the lumber yard at the north end of the grounds. The car machine and blacksmith shop is situated south of the passenger car shop, and there are also provided an iron storage house, 7,000 gal. fuel oil tank and coal house. This shop is expected to take care of all iron work for the car department, the fitting up of wheels, air brake equipment and steam hose, and pipe work.

Sewerage is collected in a waterproof sump and is then pumped to drainage and filter beds.

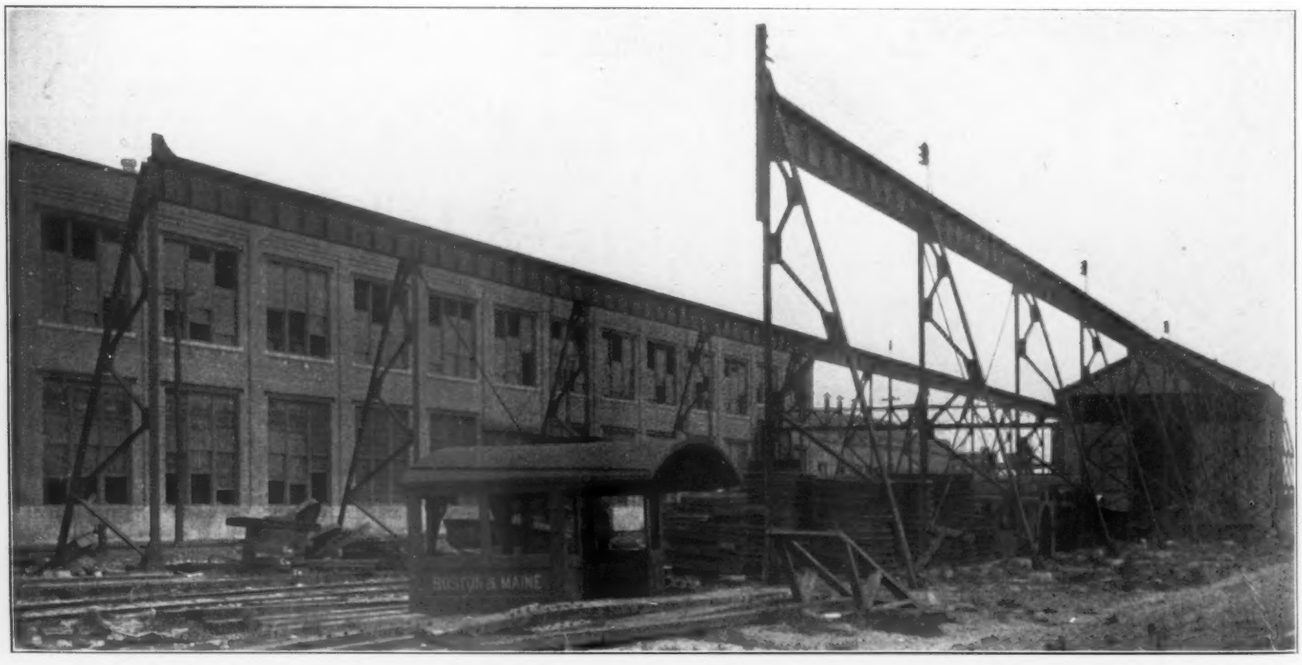
Current of 25 cycles, 3 phase, 550 volts, is supplied for all machine tools, group drives and lighting, with the exception of variable speed machines and general lighting. For variable speed machine tools direct current is furnished by a motor generator set consisting of a synchronizing motor and a direct current generator. Direct current for yard lighting and general shop illuminating is furnished by mercury arc rectifiers. It was decided to use 25 cycles, 3 phase, alternating current, in anticipation of the possible electrification of the line, which in all probability will be operated with current of these characteristics. This would permit operation of the shops from the main power house. The heating system is the forced circulation hot water system.

Store House and Office, North End

LOCOMOTIVE SHOP

The locomotive shop is 160 ft. wide by 838 ft. 6 in. long outside, with a clear height under the bottom chord of the roof trusses of 41 ft. To support the steel columns, piles were driven in clusters, 22 ft. center to center of clusters, each pile being loaded to 35 tons. The same method of construction was adopted for all buildings.

The locomotive shop is divided longitudinally by a center line of steel columns, the east half being allotted to the erecting shop, and the west to the machine shop, with the exception of 287 ft. at the south end, which is given up to boiler and tank work the full width of the shop. The erecting floor has three tracks run-



Tire Storage Yard and Crane Runway South of the Tire House

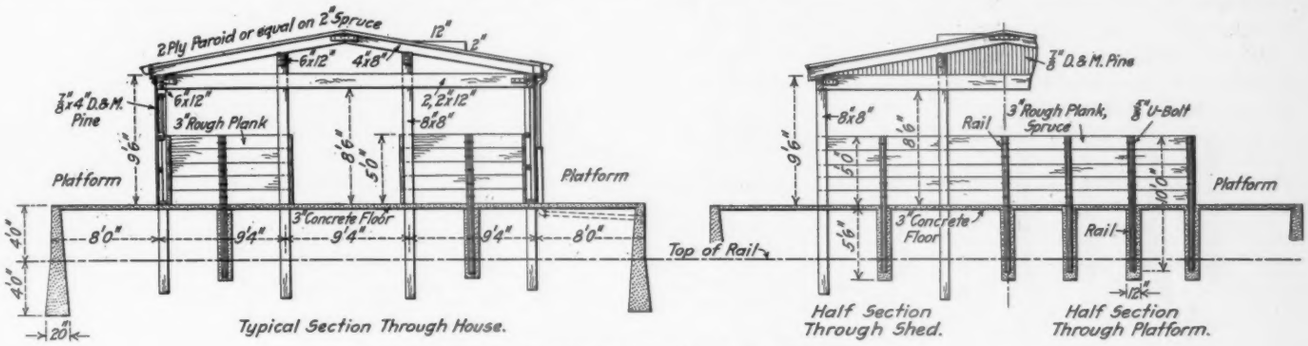
ning the full length, placed 25 ft. center to center in order to provide ample working space between engines.

The center or entrance track is intended for stripping and assembling, the two side tracks being the repair tracks; there are two stripping and washing pits, each 150 ft. long, in this center track. Without encroaching on the space allotted to the boiler shop at the south end or driving wheel work at the north end, it is possible to stand 20 engines end to end on these side tracks with ample space between engines. However, the superintendent of shops has adopted the expedient of standing engines in the herringbone fashion.

A space 100 ft. by 80 ft. at the north end of the erecting floor is devoted to driving wheel work. The facilities for removing and putting on tires are in a separate steel building east of the locomotive shop.

The erecting floor is served by two 65-ton capacity, 75 ft. 2¾ in. span, electric traveling cranes, each with a ten-ton auxiliary hoist; one ten-ton, 75 ft. 2¾ in. span, electric traveling crane at the boiler shop end and a 7½-ton crane bridge over the wheel shop end. All of these cranes may travel the full length of the shop. The height from the floor of the shop to the top of the crane rail on the runway girder is 29 ft.

The machinery bay is divided by a line of columns supporting the gallery floor and also supporting the girders for carrying the ten-ton cranes which serve the heavy machine floor, there being two of these cranes. These columns are carried through to the roof truss, dividing the truss into two spans. The gallery floor, extending from the north end of the shop to the boiler shop space at the south end, is reinforced concrete slab, supported by I-beam floor joists and steel girders. It projects beyond the line of columns and is provided with four landings for use in placing material in the gallery by means of the ten-ton cranes, which run on rails 33 ft. 9 in. above the main floor.

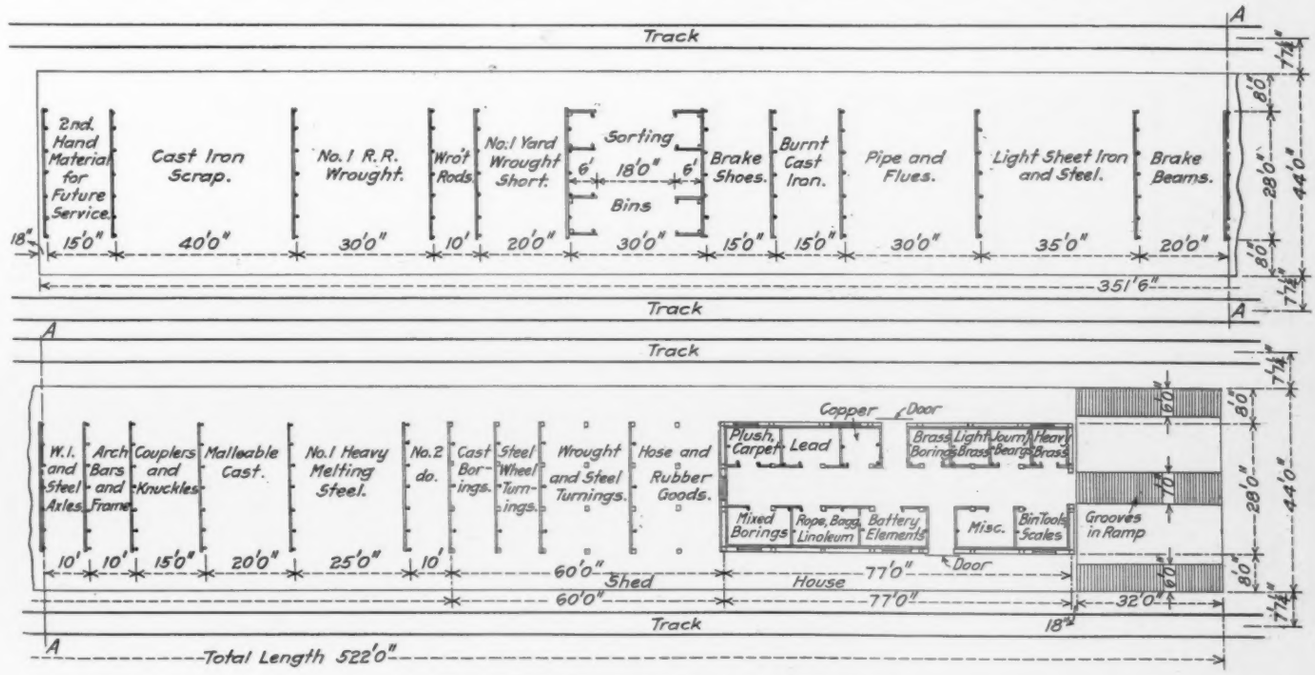


Sections Through Scrap House and Platform

Machines for driving box, shoe and wedge, valve motion and truck work have been placed under the gallery; also the tool room and the general foreman's office; while machines for brass work, finished bolts and studs, injector and air brake work and the manufacturing tool room are on the gallery. Light cab repairs and pipe work are also done on the gallery.

Pendant control trolley I-beam hoists, 1½ ton capacity, electrically operated, run the full length of the gallery, both over and under, and serve the bench aisle between the machines and wall benches. The trolley track over the gallery is provided with switches so that it is possible not only to serve the floor in a straight line, but also to serve both the main and gallery floor through open scuttles. The boiler tool space south of the gallery is served by a 35-ton electric traveling crane of 75 ft. 2¾ in. span. This crane, together with the heavy cranes over the erecting floor, covers the whole boiler shop floor space.

Locker and toilet facilities are provided in a leanto on the west



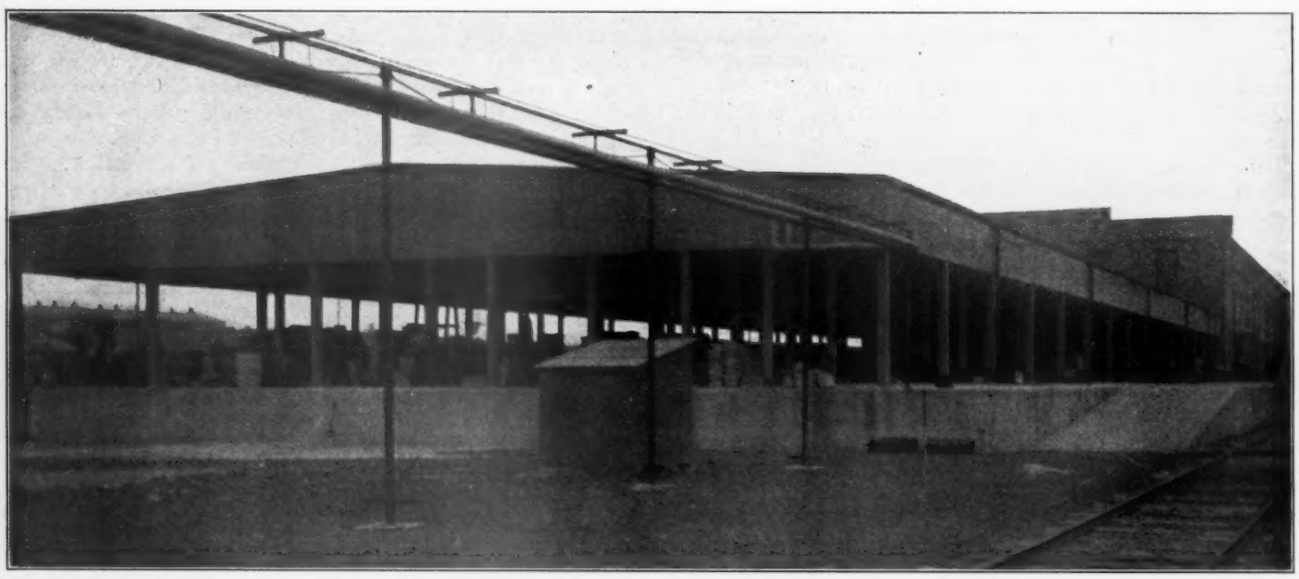
Plan Showing Arrangement of the Scrap Bins

side at the south end, on the main floor, on the gallery at the north end and on a mezzanine between the gallery and the main floor.

This shop was planned so that the hot blast system of heating might be used, and fan houses were built as leantos for this system. The economy of a forced circulation hot water system, together with the excessive cost of underground hot air ducts, determined the engineers to abandon the hot blast system. The fan houses have therefore been converted into foremen's offices and storage rooms for heavy tools.

Windows are large and frequent and the roof lighting is accomplished by means of glass roof monitors, 24 ft. by 80 ft., in alternate bays. Floor drainage and pit drainage is taken care of by a line of sewer pipe running to an open ditch on the east side of the shop yard area.

For convenience in serving mechanics with hand tools, lathe tools, etc., from the tool room and also to avoid loss of time by high-priced men congregating around the tool room window, a drop board telephone set is to be installed in the main floor issue tool room, with call stations conveniently located about the shops. The workman calls the tool room, makes known his needs and the requisite tool is sent to him by a boy who takes his brass check in exchange. This is also considered an excellent way to familiarize apprentices with the names, nature, and uses of tools. The workman has to return the tools at night. Another time saver is the location of the blacksmith tool dresser in the tool room.



Store House Covered Shed at the South End

BLACKSMITH SHOP

The blacksmith shop is a one-story steel frame and brick building 90 ft. by 332 ft. 6 in., with a clear height under the trusses of 20 ft. Locker and toilet rooms are in a leanto on the west side. The roof trusses span the full width of the shop and are designed especially heavy to permit carrying a load of five tons on any point on the bottom chord, the object of this being to provide for supporting line shaft and pulleys, overhead circular cranes, etc., there being no crane masts anywhere in the shop. This building is a combination hammer shop, general blacksmith, forging and bolt shop.

SCRAP PLATFORM AND BINS

The scrap platform is built of concrete, backfilled with sand between the walls, and with a concrete top. It is 44 ft. wide, 522 ft. long and 4 ft. high above top of the rail, with a ramp on one end. There is a house on one end 28 ft. by 70 ft. for brass, copper borings, trimmings, etc., which might be affected by the weather. The open platform space is divided into 21 bins or spaces for sorting the various grades and kinds of heavy scrap. The bin partitions are of rough plank, 5 ft. high, and bolted by means of U-bolts to old rail posts which are in turn set in concrete bases.

OFFICE AND STOREHOUSE

The two-story brick store and office building, 75 ft. by 422 ft. 8 in., is built on a concrete platform which is 110 ft. by 672 ft. The floors and roof are supported by wooden columns and timber framing. The offices are on the north end, the first floor being assigned to the shop superintendent and the second floor to the local storekeeper and his clerks and to the telephone exchange. Communication between the two floors of the warehouse portion is by means of two stairways and two electric elevators. One elevator, for freight only, is of 4000 lb. capacity, while the smaller or combination freight and passenger elevator has a capacity of 2000 lb.

The first floor of the warehouse is assigned to heavy goods, fine goods such as plush trimmings, etc., being kept in a special room built for the purpose in the north end. The floor surface is granolithic concrete laid on sand.

Bins are arranged transversely, leaving a broad working aisle through the center of the building. At the end of each transverse aisle between the bins is a window, so that there are no dark corners. All bins, shelves, racks and benches were designed for the purposes for which they were intended to be used and are built throughout of steel. The height has been kept down to six feet, so that the use of ladders to reach material is avoided. The second floor is a double wooden structure carried on wooden girders and floor joists, the bin and rack arrangement being similar to that on the first floor.

POWER HOUSE

The power house is a steel frame and brick structure 114 ft. 8 in. by 122 ft. 6 in. divided longitudinally into boiler and engine rooms, with a pump basement, pipe tunnel and ash tunnel in the boiler room side. The boiler room floor is at yard grade and the engine room floor is elevated 8 ft., providing space under the floor for piping and electric cables. There are five Babcock & Wilcox 508 hp., vertical header boilers, designed for 200 lb. pressure and with safety valves set at 150 lb. All of the boilers are equipped with Babcock & Wilcox superheaters, designed for 140 deg. superheat forced rating. One boiler has been provided with plain grates for hand firing and burning shavings and refuse from the planing mill, while four have Murphy stokers.

The induced draft is provided by a B. F. Sturtevant Company 14 in. by 7 in. fan, of a capacity of 175,000 cu. ft. of air per minute. A National feed water heater and oil separator is used.

The engine room equipment consists of two Providence Engineering Works, Rice-Sargent Corliss, horizontal, twin, single expansion, non-condensing engines for direct connection to gen-

Pipe Supports, North End of Passenger Car Shop

erators. The cylinders are 16 in. by 30 in.; two General Electric Company 20 pole, 350 kw. alternating current generators with field rheostats, direct connected to the Rice-Sargent engines; two General Electric Company exciter sets consisting of marine type engines and 50 kw. 125 volts, 280 r. p. m. compound wound direct current generators, direct connected and mounted on the same base; one General Electric Company marine type engine and generator set with direct connected exciters; one General Electric mixed pressure turbo-generator set; one General Electric synchronous motor generating set; two General Electric 50-light series mercury arc rectifier sets; one General Electric 14 panel switchboard; two Laidlaw-Dunn-Gordon air compressors, capacity 2,150 cu. ft. of free air per minute at 100 r. p. m.; one Alberger Pump and Condenser Company's Giroflow jet condensing equipment; and one ten-ton hand power traveling crane.

The heating load on the plant being far in excess of the power load, compounding the engines was not considered desirable from an economic standpoint. The exhaust from all apparatus in the power house is conducted to the heaters, which are designed with sufficient volume to relieve the engines of back pressure. Economies during the period of no heating are obtained by shutting down one or both of the main engines, and putting the turbo-generator into service. The mixed pressure turbo was installed in order to provide against the insufficiency of low pressure steam on account of the intermittent action of the air compressors and possibility of shutting down other steam auxiliaries.

LUMBER SHED

The lumber shed is a frame building 49 ft. wide by 200 ft. 10 in. long, with a center aisle 16 ft. wide running the full length, and a ventilating monitor also running the full length. The shed is built with two storage decks, the heavier material to be carried on the lower floor, the sides are provided with continuous sliding doors below and swinging doors in each bay for the upper deck.

DRY KILN

The dry kiln is built of brick with canvas curtain doors, tiled ceiling and concrete floor. It is 63 ft. by 91 ft. and divided into five drying sections. The building was constructed in accordance with plans furnished by the Andrews Dry Kiln Company, and all equipment was purchased from them. The temperature, humidity and rate of drying is in absolute control of the operator. Steam coils are placed near the floor and condensing coils on the sidewall in chambers provided for the purpose. Above the concrete floor is a wooden floor with openings running the full length of the kiln; this floor serves the twofold purpose of a walk and baffle. The lumber is piled on trucks which run over rails carried on pedestals. These trucks may be transferred with their loads to another standard gage outside truck with rails running crosswise, for transporting the dried lumber to the shops or lumber shed.

Hot air rises through the slotted openings in the floor in and around the piles until it reaches the roof; the condensing coils, which have cold water running in them, induce a downward current in the condensing chamber; moisture picked up by the hot air is deposited on these coils, and the drip is carried to suitable drains by means of copper troughs running under the condenser coils. The rate of drying is simply a question of temperature. As different kinds of lumber require different treatment, suitable valves, regulators, thermometers and hydrometers

Car Machine and Wheel Shop

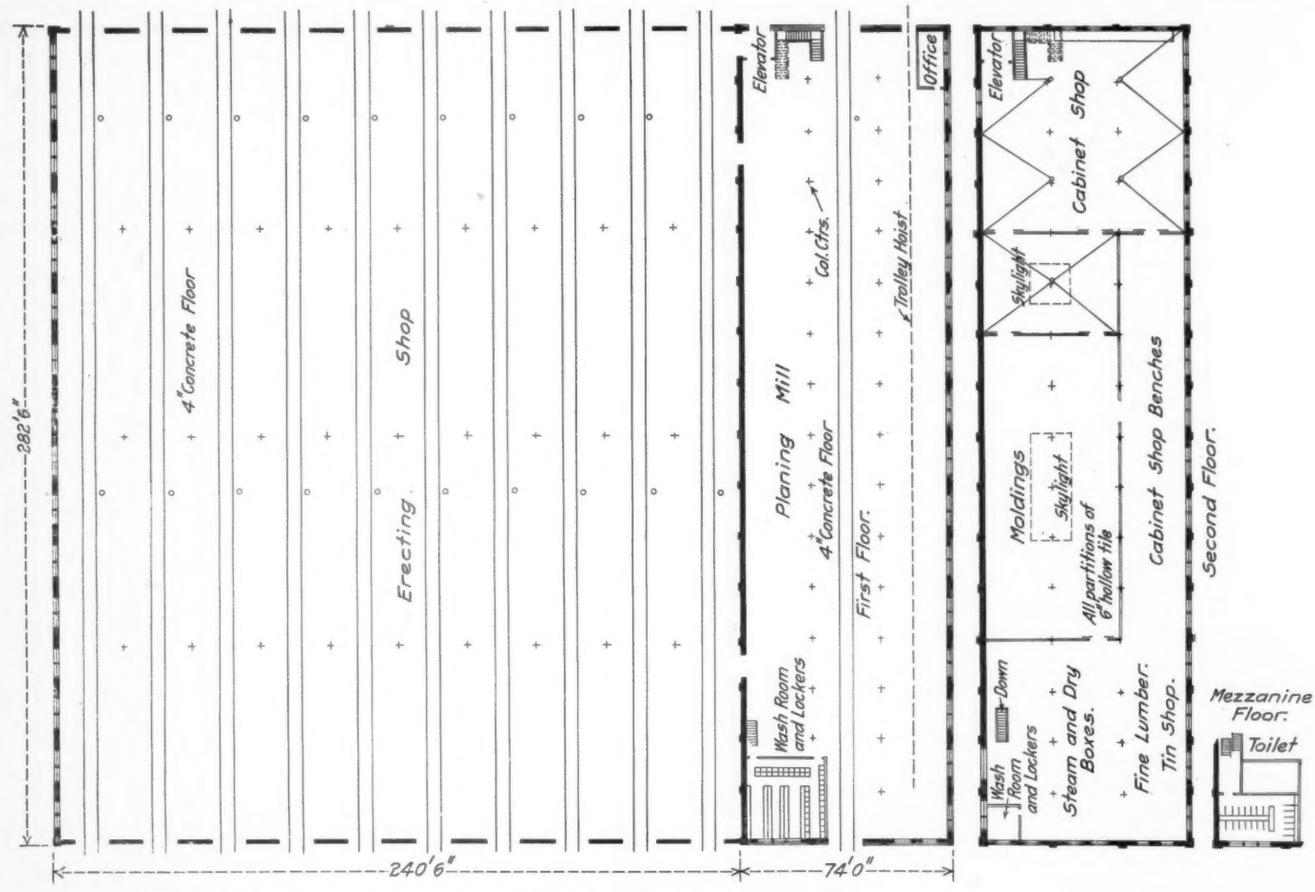
permit a nicety of adjustment for the proper treatment of any given wood.

CAR MACHINE AND BLACKSMITH SHOP

The car machine and blacksmith shop is a brick building with steel frame, 150 ft. by 200 ft. 6 in., divided longitudinally by a brick wall in which are wide doorways, one section being assigned to blacksmith work and the other to machine and wheel work. The design was decided on because of the close relationship between the two departments. The building is so located that the progress of the material may be either to the passenger car repair shop or freight repair yard in a direct line.

PASSENGER CAR SHOP

The car repair and erecting shop is a brick building 314 ft. 6 in. by 282 ft. 6 in. The one story erecting shop proper is 240 ft. 6 in. by 282 ft. 6 in. containing ten tracks spaced 24 ft. center to center. The steel roof framing has been designed so that lighting is between the cars instead of over them, there being four skylights or monitors in each bay between tracks. The two story portion is 75 ft. by 282 ft. 6 in. The first floor is used for the planing mill and will eventually become the cabinet shop, when the planing mill and freight shop are built. The second floor is used for cabinet shop, cab work, storage of kiln dried fine lumber and mouldings used for coach trimmings, steaming and drying boxes and tin shop. Communication between floors is by means of two stairways and an electric elevator. A trolley I-beam is hung on the underside of the girders supporting the second floor, projecting beyond the building; a chain hoist trolley runs on this beam for bringing heavy sills and other timbers to the woodworking tools.



Floor Plan of the Passenger Car Shop

PAINT SHOP

The construction of this building is the same general type as the passenger car shop; the lighting arrangement is of the same design and there are ten tracks 24 ft. center to center in the one story portion. The three easterly tracks are used for washing cars and are lower than the others and the concrete floor is graded to floor drains provided with screens. These empty into catch basins which in turn are connected with a drainage line leading to the old canal. On each side of each paint track counterweighted adjustable scaffolds have been erected.

TRANSFER TABLE AND PIT

The transfer pit is 80 ft. wide by 385 ft. long and 2 ft. deep from top of rail to top of rail. This pit is constructed wtih concrete side walls, reinforced supporting walls running lengthwise of the pit and all carried on concrete piles. There are five lines of tracks dividing the table into four bays, resting on yellow pine stringers which are bolted to the supporting walls. The transfer table, built and installed by George P. Nichols and Brother, is designed to handle a 75-ton car and a 117-ton switch engine; it is equipped with a 52 h. p. motor. Current is taken from overhead wires by means of trolleys mounted on a gas pipe pole at one end of the table.

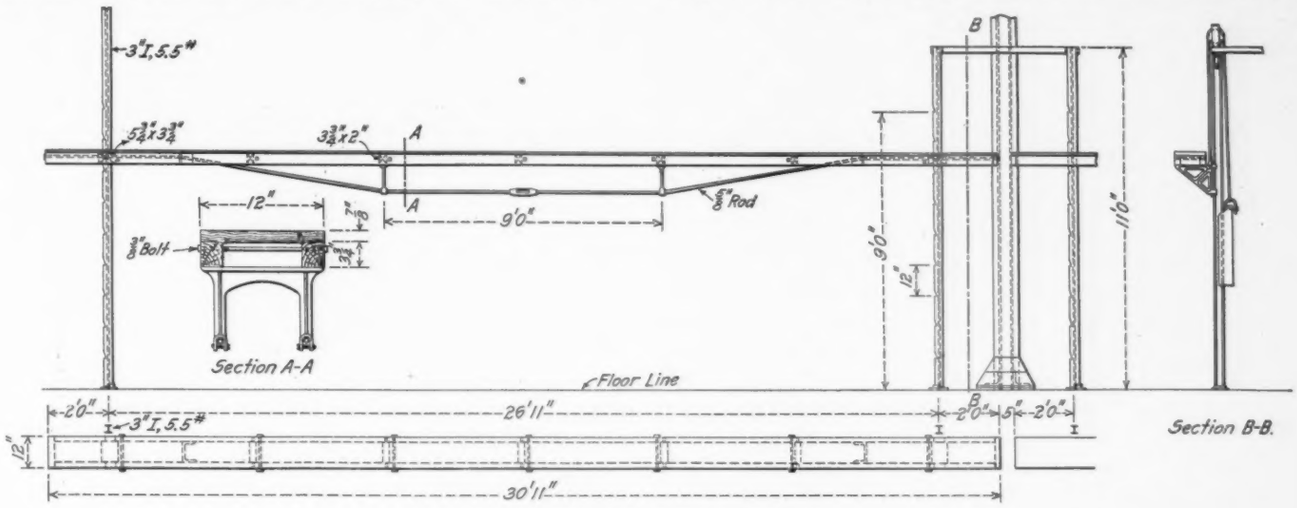
PAINT, VARNISH AND OIL HOUSE

There are two oil houses, but for the purpose of this article the larger one for the storage of paint, varnish and oil will be considered, the essential features being the same in both, the smaller of the two being used as an issue house for the locomotive shop only. This oil house is built of brick on an elevated platform and has a basement under it, the floor is carried on a steel frame and is of reinforced concrete, as is also the roof. Ventilation is provided by monitors in the roof, a ventilating stack from cellar to roof, and floor registers in the side walls of the main building. All heating pipes are in the cellar. The extension of the platform with cover shed is for caring for empty barrels. A steam pipe with valve outside is brought in the building so that

in case of fire, opening this outside valve will fill the interior with steam. All storage tanks are in the basement, there being 21 in all and on the main floor ranged along the end wall are self-measuring and recording pumps, etc., while in the floor are filler openings covered with brass floor plates. The whole equipment was installed by the S. F. Bowser Company, Fort Wayne, Ind.

taken care of by a tool committee. Valuable assistance was rendered this committee by L. R. Pomeroy, who was retained in a consulting capacity and made one of this committee.

Mr. Pomeroy carefully checked the rated output of each machine against the expected requirements and made a complete analysis of the motor and power problems. Studies made on

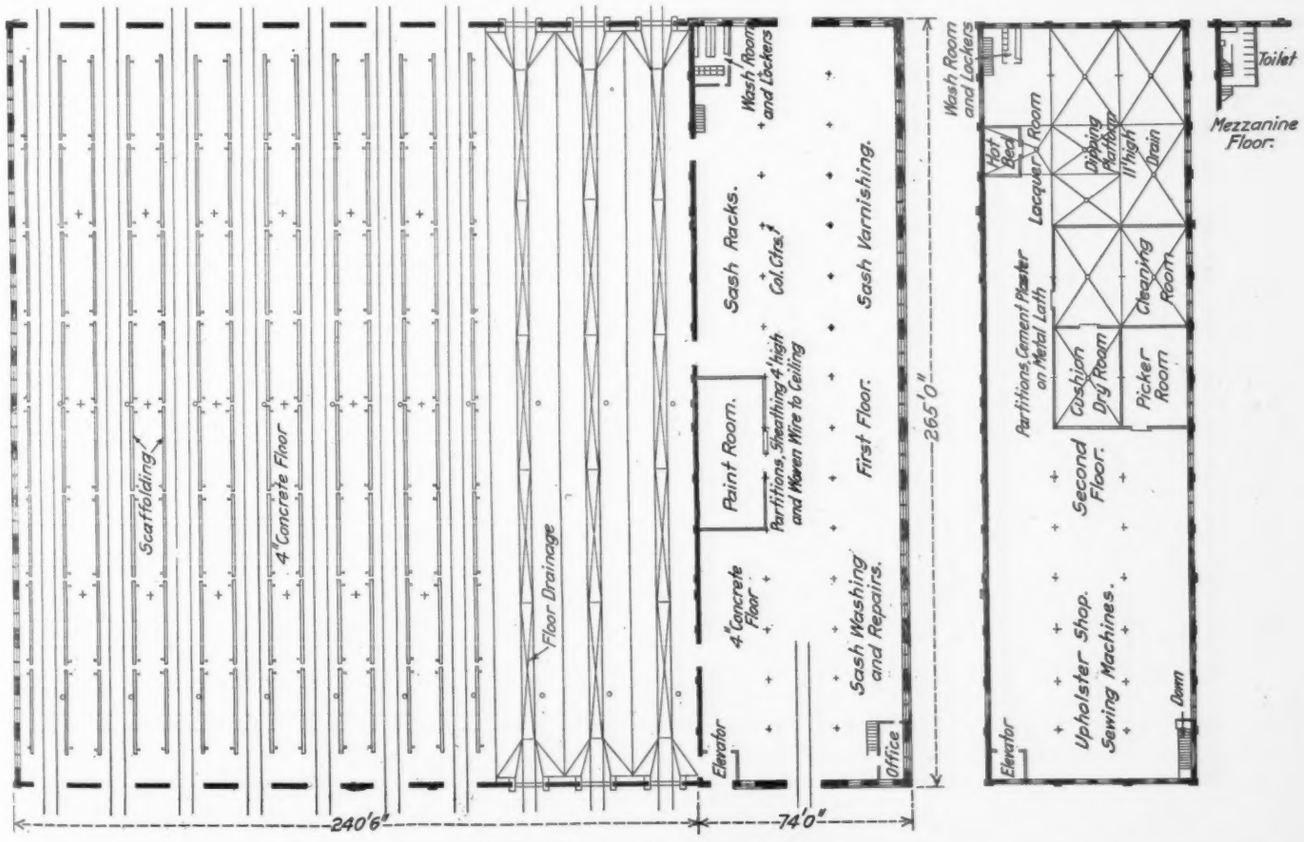


Detail of Paint Shop Scaffolding

MACHINERY AND TOOLS

The determination of the proper machine for a given piece of work, the number and size of each kind of machine requisite for

similar lines for the Lackawanna* were taken as a guide, checked up and adapted to Boston & Maine conditions as far as the locomotive department was concerned. Use was made of a thorough



Arrangement of the Car Paint Shop

the anticipated shop output, tabulation and canvass of machine tool bids, adoption of motors of proper size and type for both individual machines and group drive, and the selection of hand tools, such as taps, dies, reamers, wrenches, air tools, etc., was

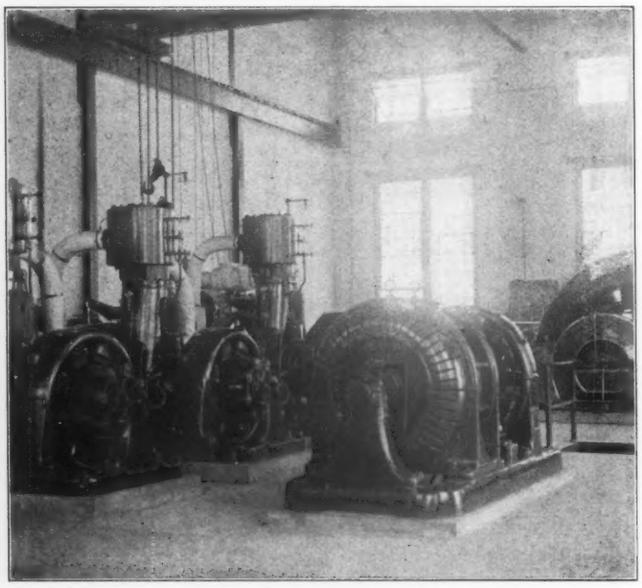
study made by Mr. Pomeroy of machine output in the Fitchburg shops for arriving at the car department equipment.

The problem, apparently simple, but involving considerable

*See *American Engineering & Railroad Journal*, April, 1909, page 120.

study was to make 30 general locomotive repairs and 180 general passenger car repairs per month. To begin with, selection was made of one of the heaviest locomotives, the various operations considered and listed, and the proper tool equipment in kind and quantity selected. This list was then carefully checked for machine output and where it was found that some of the machines were not assigned a fair proportion of the work and their determined location in the shop was such that one of similar nature was conveniently near, the particular machine was eliminated from the list. Efforts were directed towards getting a well balanced shop. It was presumed that by taking the heaviest type locomotive as a basis, enough leeway would be provided by the interjection from time to time of smaller engines, to provide for accidental contingencies and also manufacture standard parts for the smaller division shops. A certain latitude was also provided for growth or betterment of schedule. The car department study was worked out on the same lines.

The proper motor capacity was carefully checked, consideration being given to the fact that machine tool manufacturers invariably equip their machines with motors of sufficient power to meet the maximum output of which the machine is capable. For example, axles, piston rods, etc., are purchased rough turned, with a minimum amount of metal left for finishing; this may be considered the finished product of the rolling mill whereas it is the rough stock of the railroad shop. It is evident, therefore, that a lathe for finishing any of these parts would not require as high powered motor equipment as one for service in a rolling mill. The same reasoning was applied to group drive motors. The aggregate power required by all tools in a group was determined and consideration was given to the intermittent operation of the tools in the group; motors were then installed of approximately 25 to 30 per cent of the total power when all tools were in operation at the same time. This can safely be done on account of the large overload capacity of alternating current motors;

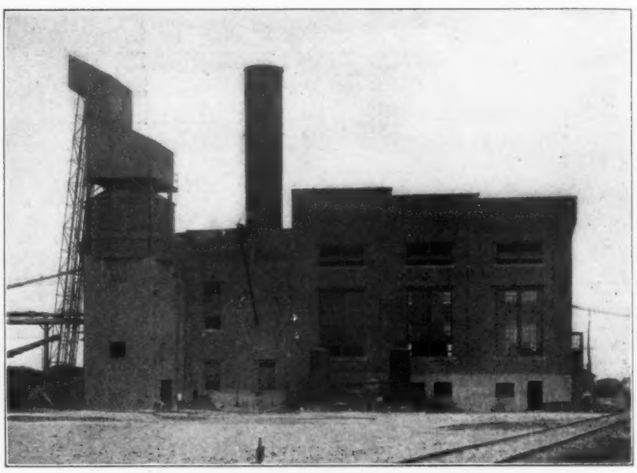


Interior of the Engine Room

further, the result of observation of motor operation in shops very similar to the Billerica shops has demonstrated that this practice is good.

Group drive motors are carried on steel brackets and shelves riveted to the steel columns supporting the shop roof. This arrangement leaves a clear way over the wall benches and in the bench aisle, permitting the use of I-beam trolley hoists in this space without the interference of the belts.

The line shaft is 2 15/16 in. diameter, running at 200 r. p. m. in boxes fitted with Hyatt roller bearings; it is put up to true line and level, throughout the full length, being sectioned for each group of machines. Sections average 44 ft. in length and are made up of two or more pieces of shaft 22 ft. long. Flange couplings are used and a space of ½ in. has been left between the ends of sections; provision has been made for connecting the whole or a part of each section to the one on either side, ½ in. fillers and bolts having been provided for this purpose. This precaution was taken to provide against the loss of use of a whole group of tools in the event of mishap to the motor driving



Power House, Showing the Coal Tower

it. Motors were purchased with pulleys standard to them and proper pulleys put on the line shaft to maintain the same speed in each group.

The equipment of these shops was made as complete in every detail as it was possible to foresee. There was installed not only a full complement of machine tools but all necessary small or hand tools were purchased or made in other division shops, and held in readiness for use when needed. The long delays incident to the opening of a new shop occasioned by the necessity of either making or buying jigs, wrenches, blacksmith tools, taps, dies, reamers, etc., was avoided. The railroad also took the precaution to train a force in other division shops to man the Billerica plant, so that when orders were given to start, the actual work of repairs began at once.

RESULT OF MASTER MECHANICS' ASSOCIATION LETTER BALLOT

The secretary of the American Railway Master Mechanics' Association has issued circular D, giving the result of the letter ballot of subjects voted on as the result of the convention at Atlantic City last June. Ten subjects were considered, and all were adopted, as follows: Castle nuts, change in specifications for steel tires, solid wedges in 5 in. by 9 in. and 5½ in. by 10 in. journal boxes, formula for main and side rods, the 6 in. by 11 in. journal box and contained parts, specifications for alloy steel forgings, specifications for quenched and tempered carbon-steel axles, etc., code for laboratory and road tests of locomotives, air brake and train air signal instructions, and the elimination of questions and answers regarding the use of air brake and train air signals. The discussion on these subjects was published in the *Daily Railway Age Gazette* of June 16, 17 and 18, 1914.

Unemployed in Germany.—The largest labor union in the Berlin district, Germany—that of the metal workers, with 88,000 members—reports 11,000 unemployed, although some 16,000 members are with the troops in the field.—*Iron Age.*

STEAM LOCOMOTIVES OF TODAY

The sub-committee of the railroad committee of the American Society of Mechanical Engineers has prepared a report in the form of a paper for presentation at the annual meeting. The report is signed by G. M. Basford, F. H. Clark and W. F. Kiesel, Jr., and will be presented in the afternoon of Wednesday, December 2, 1914, at the rooms of the society, 29 West 39th street, New York, when a full discussion is invited. The report in full is given below:

Recent progress and improvement in the efficiency and capacity of steam locomotives has been of such remarkable character and extent that a record in the proceedings of this society is justified.

Steam and electric locomotives as rivals in the same field has been a favorite subject for discussion before engineering societies, and it is easy to start arguments in favor of each of these rivals among the partisans interested. Whether or not the steam locomotive is to be displaced by the electric is, of course, an important question which will in time be settled by the court that settles all such questions, that of the treasurer's figures. For the present and for the immediate future the burden of transportation falls and will continue to fall upon the steam locomotive. If the steam locomotive is to be perpetuated it is fitting that it should be improved to the utmost limit. If it is to be finally displaced it is fitting that it shall be so improved in order that progress to something better shall be intelligently developed upon a solid foundation. This discussion will be confined to the steam locomotive, its progress in the recent past, and its possibilities for the near future.

PROGRESS IN CAPACITY

While efforts individual in character and extent were made in this country before that time, the first consistent and systematic plan to secure the utmost power of locomotives within given restrictions of weight and cross-section clearance was inaugurated 20 years ago. This plan began with an eight-wheel or American type passenger locomotive, built for an eastern railroad in January, 1895. This locomotive weighed 116,000 lb., with 74,500 lb. on driving wheels. It provided a tractive effort of 21,290 lb. While this locomotive was not the most powerful in passenger service at that time, it was the first of a chain of passenger locomotives leading in a connected series by the same builders, up to and including recent designs of the Mountain type, representing the largest passenger type of present practice. This type has four-wheel leading trucks, eight driving wheels and two trailing wheels. The largest of the Mountain type weighs 331,500 lb. with 240,000 lb. on driving wheels and produces a tractive effort of 58,000 lb., or about three times the tractive effort of the first design of the series built during a period of 20 years.

In the year 1898 the engineering and railroad world was interested by the appearance of the largest and most powerful locomotive built up to that time. This was of the Consolidation type with a two-wheel leading truck and eight driving wheels. This locomotive was built in Pittsburgh, and for a number of years was the largest and most powerful of its type, and the largest and most powerful locomotive in the world. Its total weight is 330,000 lb., weight on drivers 208,000 lb. and tractive effort 53,300 lb.

Today the most powerful freight locomotive has two leading and two trailing wheels and 24 driving wheels. It gives a tractive effort of 160,000 lb. and weighs 410 tons. This locomotive has hauled a train of 251 freight cars weighing 17,912 tons, exclusive of the locomotive. The total length of the train was 1.6 miles, the maximum speed attained was 14 miles per hour. This required a maximum drawbar pull of 130,000 lb. This locomotive has six cylinders and three groups of driving wheels.

A freight locomotive has recently been built having two cylinders and a single group of driving wheels which develops a tractive effort of 84,500 lb. Such has been the progress in capacity.

This progress has been rapid, perhaps somewhat too rapid with respect to improvements in operating facilities and progress in other features of railroad equipment. It has been rendered possible by corresponding developments of factors making for greater efficiency in boilers and in engines. During the past 20 years in this country locomotive development in capacity and in efficiency, particularly during the past five years with respect to efficiency, has been remarkable, and is worthy of record with progress in marine and stationary engineering.

In Europe the relatively high cost of fuel led to efforts to improve efficiency before this problem aroused serious attention in this country, but physical limitations more rigidly restricted the size and weight of locomotives in Europe. Our problem is to secure maximum efficiency combined with great size, great weight and great power which is more difficult. Since the development in the size and weight has been tremendous, even though these limits may not yet have been reached, it is now appropriate to concentrate on efficiency.

For a number of years the physical capacity of the fireman to shovel horsepower through the fire door determined the capacity of the locomotive at speeds. Mechanical stokers have removed that limitation. It is now possible to fire six tons, and more, of coal per hour into a locomotive firebox. This has changed the problem into one of getting the maximum amount of heat out of the coal and using it economically in the cylinders. With the large figures now prevailing for drawbar pull and weight it is fitting that closest attention should be given to the best possible use of every pound of metal and every pound of coal. Due to recent application of several economy producing and capacity increasing factors great improvements have already been made with promise of more to come. Then the great work of building up the efficiency of the average locomotive to the standard of the best will follow.

Among these economy producing and capacity increasing factors are the following improvements:

Boiler design in the relationships of the factors making up heating surface;
Firebox design;
Front end design, draft appliances, exhaust nozzles;
Ashpan design as to air openings;
Superheating;
Compounding;
Feedwater heating;
Firebrick arches and circulating supporting tubes;
Valve gear;
Detail design to secure reduced weight of reciprocating parts and other parts;
Use of high-grade alloy steels to reduce weights;
Mechanical stokers;
Labor-saving devices for the engineman and fireman;
Improved counterbalancing to permit of greater weight on driving wheels by reducing dynamic stresses;

And yet to come is powdered fuel with possibilities unknown in scope and in importance. Powdered fuel is in reserve, promising the ideal method of complete combustion under control more perfect than is possible with present methods other than oil burning and perhaps with economies impossible to obtain with oil.

PROGRESS IN EFFICIENCY

Valuable comparisons may be drawn from the best results of ten years ago and of today. At the Louisiana Purchase Exposition in 1904 the tests made by the Pennsylvania Railroad revealed important figures concerning locomotive performance at that time. It was shown to be possible to obtain equivalent evaporation from and at 212 deg. of 16.4 lb. of water per sq. ft. of heating surface, indicating the power of locomotive boilers when forced. It was shown that when the power was low, the

evaporation per pound of coal was between 10 and 12 lb., whereas the evaporation declined to approximately two-thirds of these values when the boiler was forced. These results compared favorably with those obtained in good stationary practice, whereas the rate of evaporation in stationary practice lies usually from 4 to 7 lb. of water per sq. ft. of heating surface per hour. In steam consumption the St. Louis tests showed a minimum of 16.6 lb. of steam per i. hp. per hour. In coal economy the lowest figure was 2.01 lb. of coal per i. hp., the minimum figure for coal per dynamometer horse power was 2.14 lb. These records were made after the superheater had become a factor in locomotive practice and they represent economies attained by aid of the superheater in one of its early applications. This is important in the light of the recent development of the superheater. These remarkable figures have never received the attention which they deserve from engineers. They serve, however, to show that 10 years ago a steam locomotive had attained results which were worthy of the best attention of the engineers of the time. Since then greater progress has been made and today locomotives of larger capacity than those concerned in the St. Louis tests have given better results.

Voluminous records of recent investigations of locomotive performance taken from the Pennsylvania Railroad test plant at Altoona show that the best record of dry fuel per i. hp. hour down to the present date is 1.8 lb., with a large number of less than 2 lb., while the best performance in dry steam per i. h. p. hour is 14.6 lb. with a large number less than 16 lb. A reduction of 10 per cent in fuel and 12 per cent in water is remarkable as the result of a development of 10 years. This coal performance was recorded by a class E6S Pennsylvania Railroad locomotive while running at 320 r. p. m. and developing 1,245.1 i. hp. The same locomotive gave a fuel rate of 1.9 lb. while running at the same speed and developing 1,750.9 i. hp. The best water rate was given by a class K2SA Pennsylvania Railroad locomotive while running at 320 r. p. m. and developing 2,033.1 i. hp. These high powers indicate that the locomotives were not coddled as to output of power in order to show high efficiencies, but that high efficiencies accompany actual conditions of operation in severe service. As to power capacity expressed in terms of evaporation, it is interesting to note that the maximum equivalent evaporation from and at 212 deg. per sq. ft. of heating surface per hour on the Altoona test plant is 23.3 lb. These figures of high efficiency were obtained from locomotives which represented not only very careful, general and detail design, but their design included several of the improvements making for greater capacity and higher efficiency, without which the results could not have been attained.

Having in mind the facts that steam locomotives are power plants on wheels, built to meet rigid limitations of weight, both static and dynamic, and that the use of condensers is impossible, engineers in general must admit the high character of the work of locomotive designers which has attained these results.

Greater efficiency, which is revealed on the test plant and through reports of engineers, would be important because it proves that progress is being made in the possibilities of locomotive performance. Improvement which is revealed by operating statistics and which, therefore, appears in the records of the treasurer's office is the real test in this case. It is important to know that increased power of locomotives, attained largely through the development of economy-producing and capacity-increasing factors, has produced results which the financial reports of railroads prove beyond question. A recently published list of train tonnage on 45 prominent railroads indicates that 16 of these roads have increased their average freight trainloads by over 30 per cent during the last five years. Credit must be given to the improvement in the locomotive for most of this development. These figures reveal the value of increased power and efficiency of steam locomotives and the end is not yet in sight.

WHAT REMAINS TO BE DONE

American locomotive development to its present state would have been impossible without the use of the improvements already mentioned. It is believed that all these are capable of still further development, making for still greater economy in the use of fuel and, therefore, promising greater power capacity. It is the object of the committee to present these possibilities for discussion by those who are engaged in perfecting and improving steam locomotive practice in this country. It is the hope of the committee that engineers who are devoting their attention to the design of locomotives as a whole and those who are engaged in the development of the various details which have contributed to the high efficiency of the steam locomotive of today will discuss the progress of the recent past and reveal possibilities for future development and improvement in capacity and efficiency.

TESTS OF THE WEATHERING OF PITTSBURGH COAL

The results of investigations into the weathering of the Pittsburgh coal bed at the experimental mine of the bureau of mines near Bruceton, Pa., are detailed in Bureau of Mines Technical Paper 35, which has recently come from the public printer. The authors, Horace C. Porter and A. C. Fieldner, outline the results of their investigation as follows:

The data obtained show the extent of alteration by weathering in the Pittsburgh coal bed as situated in this particular mine and will serve as a basis for approximate estimates of the alteration of the same bed in other mines similarly situated. The results have demonstrated that indications of weathering such as yellowish coatings of iron hydrate or a dull appearance of the surfaces, do not always signify a material change of the chemical composition or heating value of the coal itself.

The chemical analyses show that changes in composition have occurred in the coal for a distance of about 50 ft. from the outcrop. The analytical data serve as a basis for certain deductions as to the nature of these changes. Several points of similarity become evident between weathered coal of this character and the Cretaceous coals and lignites. On the other hand, certain dissimilar properties of the two render it altogether doubtful whether a true metamorphosis or reversion of the bituminous coal to the lignitic type could ever take place through the agency of weathering. The analyses also show that the composition and heating value of the unweathered coal, computed on the moisture and ash free basis, are fairly constant.

In addition to the usual analyses, special tests were made in order to show the relative oxygen-consuming power of the coal samples and their power of liberating inflammable gases, because these properties are known to vary with the nature of the coal and have a bearing on mining operations. As the direct union of freshly broken coal with oxygen lowers the oxygen content of mine air in places where ventilation is inadequate, and as the continuous escape of inflammable gas from broken coal tends to increase the danger of explosions, it is of interest to determine to what extent this behavior of coal is affected by proximity to the outcrop and consequent weathering.

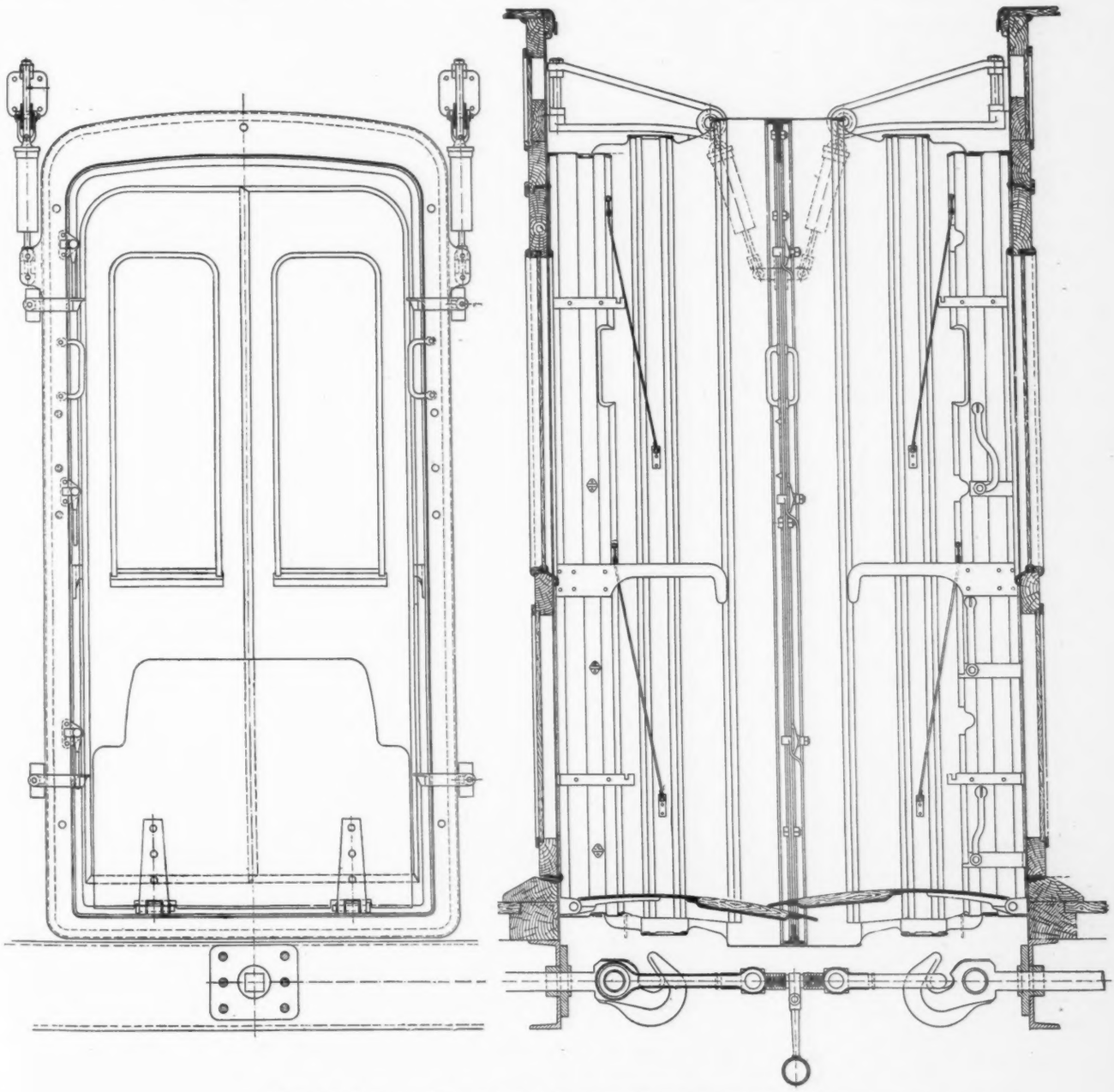
Samples were taken at different points in the mine and put in 5 gal. glass bottles, the coal being crushed so as to pass a ½ in. screen; 20 lb. was placed in each bottle as quickly as possible after the coal had been broken down and the bottle was sealed before it left the mine. By admitting air to the bottles in measured quantities daily and drawing off the air and gases the progress of oxidation of the coal and of the liberation of inflammable gas was followed. The samples thus tested were taken at 5 ft., 50 ft. and 620 ft. from the outcrop.

CAR DEPARTMENT

EUROPEAN VESTIBULE CONNECTIONS

For the purpose of providing a closed passageway between coaches, folding bellows extensions are in common use in Europe. These have inherent defects which tend toward high first cost and cost of maintenance. The uneven surface offers many opportunities for the deposit of coal, snow, etc., and the collection of such substances in the spaces at the top often makes it very difficult to close the extension, this sometimes being impossible. Sparks become embedded in the folds and are likely to cause fires and the construction of the arrangement also is such that considerable wear takes place by its rubbing on coupling apparatus and other parts of the car. Moreover, if this type of extension becomes wet and is later folded it has no opportunity to dry, with the result that the material and the seams soon wear out.

A type of connection or "binding cover" which has not these disadvantages has recently been devised and placed in service. This is shown in the illustrations and consists of three metal frames connected by canvas and leather. The first of these frames, which is of wrought iron, is attached to the end of the car and attached to it is a flexible connection, the top part of which is of leather and the sides and bottom of canvas. To this is attached a frame of hard aluminum and another flexible



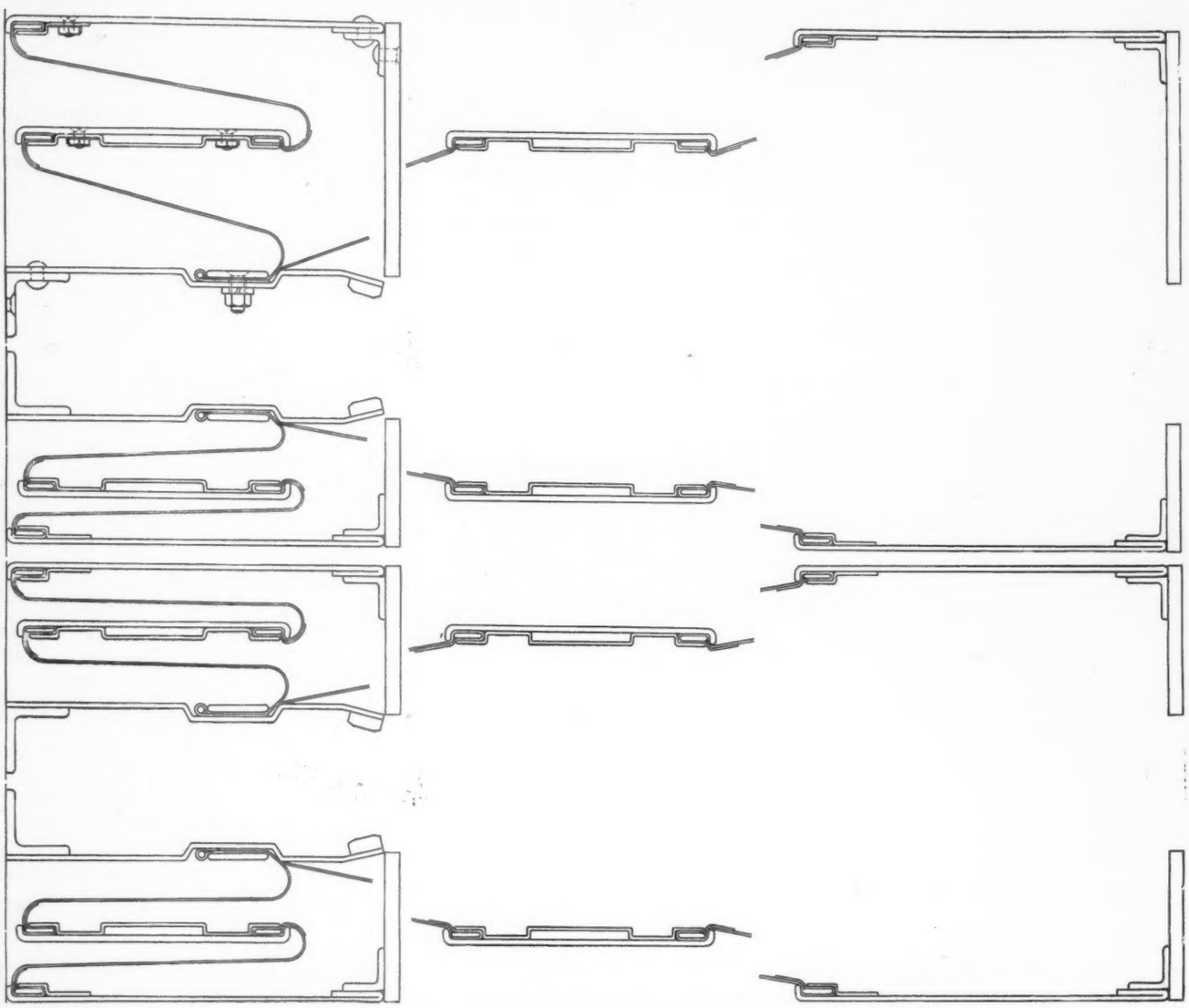
End and Side Elevations of the New Connecting Passage for Coaches

connection is placed between this aluminum frame and the outer frame, which is of iron. [Evidently aluminum is used for the middle frame in order to make it as light as possible as because of its position it cannot be provided with such substantial support as the other two frames.]

Cars equipped with this connection can be used in the same train with those equipped with the old bellows extension and the old and new types are shown connected in one of the illustrations. The outer or coupling frame in the new apparatus is hung on movable pulleys and springs, as is customary in the other type. The middle frame is supported by the two flexible connections, and it is also connected to the inner frame by chains or cables. The three frames are made of such sizes that they can be pushed one within the other, so that the two flexible connections collapse and the entire structure is enclosed. In making the fastenings between the rigid frames and the flexible connections the edges of the latter are bound round a metal stiffener and then screwed or riveted to the metal frame.

The exterior surface presented is sufficiently smooth, so that there is little likelihood of soot, etc., adhering to it; but because of the tendency of cinders and snow to collect on the top of the structure the spaces between the iron frames are made as large as possible at that point. Between the floor and the side walls of the flexible cover open slits are provided which allow water to trickle down along the side walls and through which refuse can be removed from the floor of the vestibule. The parts of the extension are so fastened to the car that they do not come in contact with the couplings and conduits and damage from rubbing on these parts is therefore prevented. When closed the flexible parts lie loosely in a hollow space to which air has access so that when folded they are removed from the effects of the weather and can easily dry.

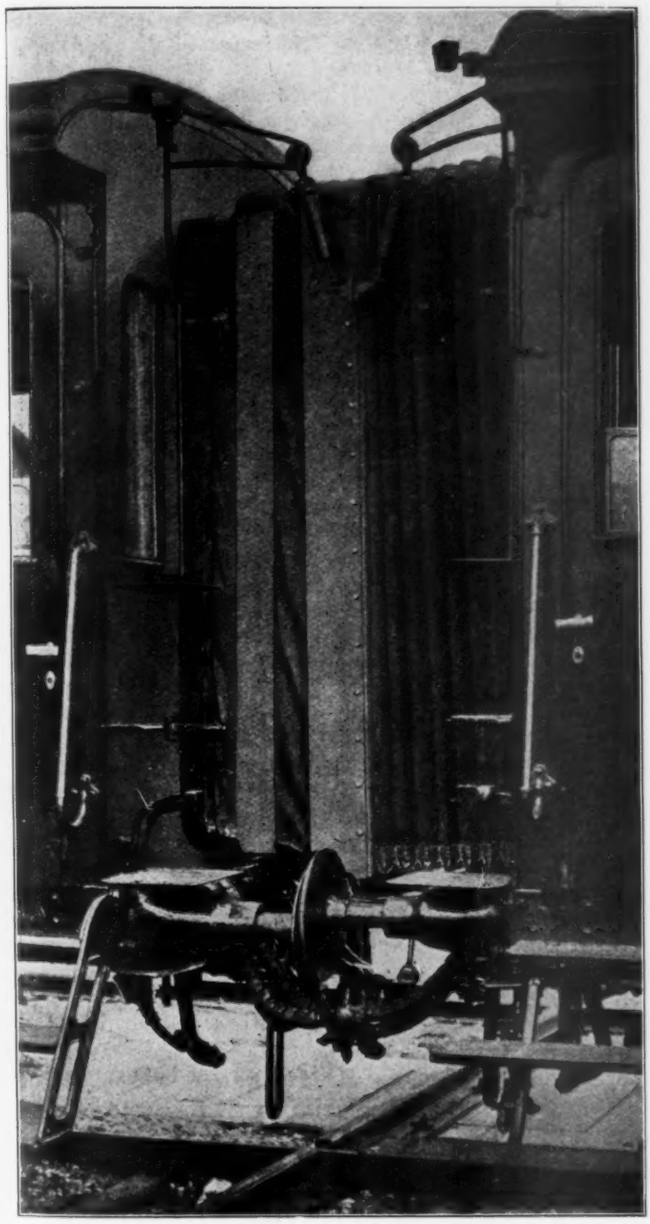
It will be seen that the only parts of this type of connection which are subject to wear are the flexible connections between the metal frames while in the folding bellows extension all parts of the device receive practically the same amount of wear and tear. It is therefore claimed that the new arrangement requires very little heavy repair work, and such repairs as are necessary are cheaper and more easily made than those on the older type.



Vertical (Upper Half) and Horizontal (Lower Half) Sections Through the Binding Cover in Closed and Open Positions; In the Latter the Flexible Connections Are Shown Broken Away, the Relative and Not the Actual Positions of the Three Metal Frames Being Shown

The Swiss Railway Alliance has two cars equipped with these binding covers, and they have met with marked success in express trains operating over considerable distances where it was necessary to make frequent changes, necessitating the coupling and uncoupling of cars. The experience gained in this service led to several improvements, particularly along the lines of

providing for the quick renewal of the flexible connections when this becomes necessary. During the most severe cold of the winter of 1913 no trouble was experienced from freezing, and the connections were easily movable at all times. It is expected



The Car on the Left Has the New Type of Connection; That on the Right the Old Extending Bellows Type

that this type of vestibule connection will be placed in general use in passenger service.—*Organ fur die Fortschritte des Eisenbahnwesens in technischer Beziehung.*

VANADIUM STEEL FOR BLOW PIPES.—An interesting characteristic of chrome vanadium steel has been demonstrated by tests made on blow pipes used by lamp blowers. The pipes used in the manufacture of incandescent lamps have been soft steel or Norway iron because such material is easy to weld and does not readily oxidize. But the hot glass clings to soft steel or iron so tenaciously that the pipe has to be hammered to remove it, thus requiring frequent repairs. This is not true of chrome vanadium steel; the glass cracks off freely and consequently repairs to pipes of this material are much less frequently required than to pipes made of iron or soft steel.—*Machinery.*

RESULT OF M. C. B. LETTER BALLOT

The Master Car Builders' Association has issued circular No. 7 which gives the result of the letter ballot on subjects considered at the 1914 annual convention of the association. A total of 101 subjects was voted on, with as many as 2,150 votes being cast on some of the subjects. The following is the result of the letter ballot:

Standard and Recommended Practice.—Eleven subjects were considered in this report. The elimination of the skeleton wedges and the change in the coupler yoke, as suggested in the committee's report, were adopted. The location of the signal lamp socket and the marking of freight equipment cars, however, were rejected. The 6 in. by 11 in. journal box lid key was adopted as recommended practice, and the following subjects were advanced from recommended practice to standard: 6 in. by 11 in. journal box and details, 6 in. by 11 in. journal bearings, wedge gage and dust guards; end for a hopper door operating shaft; brake cylinders and triple valves for cars built after January 1, 1915; location of bolting lugs of air brake hose; hose labels; and dimensions for steel and steel tired wheels.

Train Brake and Signal Equipment.—The design of conductor's valve, the method of cording and the number to install, together with the color and material of the cord for the conductor's valve and signal valve were rejected. The revision of the air brake and train air signal instructions and the elimination of questions and answers regarding air brakes were adopted.

Brake Shoe and Brake Beam Equipment.—The revision of the specifications for tests on No. 2 brake beams, as presented by this committee, was rejected. The question as to whether the No. 2 brake beam should be adopted as recommended practice was also rejected by a large vote.

Car Wheels.—Every subject referred to the association for letter ballot in this report was adopted. They are as follows: Change in the wheel defect and worn coupler gage, change in specifications for thermal tests for cast iron wheels, change in the method of marking wheels, change in the title of M. C. B. sheet *M*, change in specifications for branding solid wrought-steel wheels, diameters for steel tired wheels, diameters for wheel centers, method of mounting tires, and the maximum and minimum flange thickness gages.

Car Trucks.—A number of subjects was voted on under this committee report. The limiting dimensions for cast steel truck sides were adopted, but the specifications and the variation in weight of truck sides were rejected. The recommendations of the committee for the rejection of truck sides and for the gages for cast steel truck sides were adopted. The designs submitted for 80,000-lb., 100,000-lb. and 140,000-lb. cast steel and pressed steel bolsters were all rejected, as were the specifications for the cast steel bolsters. The gages for the truck bolsters, together with the side bearing clearance of new cars, was adopted, but the spread of the side bearings was rejected. The construction of center plates for standard freight cars, as suggested for the different capacity cars, was rejected, as were the gages for center plates and a suggestion for the elimination of safety hangers. The recommendations concerning truck springs, however, were adopted.

Train Lighting.—Under this report the pulley seat for tapered or straight axles, the use of safety hangers for battery box trays and the change in shape of the electric light bulbs were adopted, but the dimensions given for battery boxes were rejected.

Tank Cars.—The suggestions made by this committee were all adopted and consist of an addition to the general requirements of tank car specifications, a revision of sections five and seven in the specifications, and the addition to them of section eight.

Specifications and Tests for Materials.—All the specifications submitted by this committee were adopted except one. Those adopted consisted of specifications for air brake and signal hose, welded pipe, heat treated knuckle pins, steel axles, refined

wrought iron bars, helical springs, and chains. The specifications for air brake and signal hose and steel axles were advanced to standards of the association. The specification for journal box brasses was rejected.

Car Construction—Under this report the minimum requirements in the center sill design for new cars, the design and strength of ends for new box cars, and the placing of placard boards on box cars were adopted, but the specifications for car doors and the suggestions of the committee concerning draft gears were rejected.

Loading Rules.—All the changes in the loading rules were adopted.

The reports of the committees which were voted on in this letter ballot were published in the *Daily Railway Age Gazette* of June 11, 12 and 13, 1914.

SAFETY APPLIANCE STANDARDS*

BY R. M. BERG
Inspector of Contract Work, Lake Shore & Michigan Southern, East Rochester, N. Y.

It will be my endeavor in what follows to bring before you the reasons for the passing of the Safety Appliance Act, as they have come to me in looking over government reports and to recall to you in a way, why safety appliances have become standardized.

In the early stages of railroading, the equipment of the different roads was but a matter of conjecture to the heads of those roads, and interchanging of equipment with that of another road was not thought of. The necessity of standard equipment, as well as rates, was not felt; but as the commercial possibilities grew it became necessary to bring this equipment and the rates to a standard, so that delay in the transporting of commodities would be eliminated and the public given better and more evenly rated service. Having grown from a private business to one of national scope, the railroad affected the people more directly than before as it became a necessity. This brought about federal action and the Interstate Commerce Commission was appointed to regulate commerce and that which appertains to it.

Freight equipment was being damaged, the lading lost or demolished and the numerous accidents caused the Interstate Commerce Commission to co-operate with the more aggressive roads, and in 1895 the standard height of draw bars was decided upon after consulting with the American Railway Association. In 1898 it became necessary to have all trains engaged in Interstate Commerce equipped with 50 per cent automatic brakes, amended in 1910 to read at least 85 per cent. Along with this came the automatic couplers, and as a matter of safety, grab irons or hand holds were required to be securely fastened to the ends and sides of cars.

The rapidly increasing business was so great and accidents occurred with such rapidity on account of the inefficient appliances provided to protect the employee, that the commission had to again assert itself and co-operate with the employee as well as the employer, and established in 1911 a set of dimensions and clearances for freight equipment that would govern all common carriers engaged in interstate traffic. In compiling this code, it was apparently their idea to employ only such appliances as would be of need to protect the life and limb of the employee and yet not necessitate an unnecessary expenditure of money on the part of the company.

While I am not an authority as to the exact reasons given for each dimension and clearance, deduction points towards a few of them as given below; these may appear very plain and apparent reasons, but it is just my intention to recall these to your mind.

*From a paper read at the meeting of the Niagara Frontier Car Men's Association, Buffalo, N. Y., September 23, 1914.

"Hand-brakes shall be of an efficient design and work in harmony with the power brake." Should they not work in harmony a separate set of brakes would be necessary.

"The brake shaft should not be less than 1¼ in. in diameter." This was found to be the smallest practical diameter to withstand the maximum power in setting the brakes, with a small allowance for safety. Welds, on account of the uncertainty of true welding, were impractical.

A 15-in. brake wheel was found to be of such size as to provide sufficient leverage to set the brake with the strength of an average man. Any material other than malleable iron, wrought iron or steel, would either not be of sufficient strength or would not be economical.

The brake shaft is located in such a position that it will not interfere with the efficiency of either the running boards or end ladder.

A 4 in. clearance around the brake wheel is allowed as being a minimum space wherein a man can effectively operate the brake with safety.

The brake shaft step, gooseneck or stirrup, as it may be colloquially termed, being of U shape, provides the greatest degree of efficiency while setting the brake, as it guards against the tangling up of the brake chain.

The square fit at the top of the brake shaft gives better results by not permitting the brake wheel an undesired amount of freedom as is often found the case with a round fit. The taper of 2 in 12 is in common use in mechanical work.

Running boards are given a width that will allow a man to walk on them without the necessity of stepping off when he becomes momentarily unbalanced by the motion of the car. The latitudinal one is wider, as it is placed near the end of the car and where one may become more affected by the height; also to cover extreme widths allowed for locations of the ladder on the side of the car.

The 19 in. spacing of ladder rounds is the average height of a man's foot from the floor when his knee forms a right angle.

The 16 in. length of tread is long enough to conveniently place both feet on the ladder round without interference or extra precaution.

The 8 in. spacing from the end or side of the car to the inside of the ladder is a maximum distance in which a man can conveniently reach around from one to the other without stretching.

The end and side ladder rounds coinciding produce safety on account of the dependability upon where one is to step when he passes from one to the other.

A 2 in. clearance is given because the length from the middle of the second phalanx of the middle finger of a man's hand is approximately 1½ to 1¾ in. The other quarter inch is allowed as a margin of safety; also it allows a depth great enough to secure a foot hold.

The end clearance of 12 in. allows a minimum space of 24 in. for a man to utilize to work in or in climbing an end ladder between two cars, should he be forced to go between them. This is the minimum space used by a man of average size.

Roof hand holds are spaced between 8 and 15 in., on account of the average length of a man's forearm with fist doubled up being 15 in.; 8 in. allows a more convenient distance with a location such as to secure a safe application.

The location of side and upper end hand holds is such that it is in a line parallel to a man's head, a convenient distance for a man to reach without losing his bearing. The lower end hand holds are located in such a position as to be easily accessible should a man be forced to use them while between cars. The additional end hand hold used with the outside end sill is located at such a height as to be convenient in passing between two coupled cars.

I have found it a matter of great convenience when studying this act to think of these deductions with the figures themselves, as they provide a better basis upon which to work.

STEEL CABOOSE FOR THE PENNSYLVANIA

An Eight-Wheel Car, 29 Ft. Long and Weighing 38,000 lb.; Design Has Not Yet Been Standardized

The Pennsylvania Railroad has recently designed and built at Altoona an all-steel cabin car or caboose designated as class N-5. This car has not been made standard, but is a tentative design and will be thoroughly tried out on different parts of the road before a decision is made as to its suitability. The severe conditions to which the car will be subjected made it necessary that the construction be as strong as that of heavy steel freight cars, and very careful consideration has been given to each feature of the design, including those which tend to add to the comfort and convenience of the trainmen.

So far as can be learned, this is the first all-steel caboose ever built, the inside lining, the flooring through the passageway, the platform floor and the window sash being the only parts for which wood is used. The car weighs 38,000 lb. and is 31 ft. long from face to face of drawheads, 14 ft. 9½ in. high over the cupola lamp, and 10 ft. 2½ in. wide over handholds. There is a 30 in. platform on each end, with a 1¾ in. floor and side box steps. Ratchet hand brakes are used.

First All-Steel Caboose Built for Service on the Pennsylvania

UNDERFRAME

The center sill construction of the underframe is similar to that used on the Pennsylvania's steel freight cars, being composed of two 10 in. 25-lb. channels, a 21 in. by ½ in. cover plate riveted the full length of the center sills, and a 4 in. by 4 in. by ¾ in. angle riveted to the bottom of each channel on the inside, and extending continuously between back draft lugs, the total area being 36 sq. in. This construction is reinforced by a striking plate at each end, a center plate reinforcing casting above the center plate, and pressed steel spreaders between the diaphragms. The front and back draft lugs are cast integral with the striking plate and the center plate reinforcing castings. Two dished diaphragms ⅜ in. thick are located 3 ft. 7 13/16 in. on either side of the center line of the cupola, which is 12½ in. off the center line of the car, and are riveted to the center and side sills. The usual body bolster has been eliminated and the body side bearings are supported by steel cantilever castings, which are riveted to the center sills and to a ½ in. tie plate, which extends across the bottom of the center sills and outward to the ends of the side bearing castings.

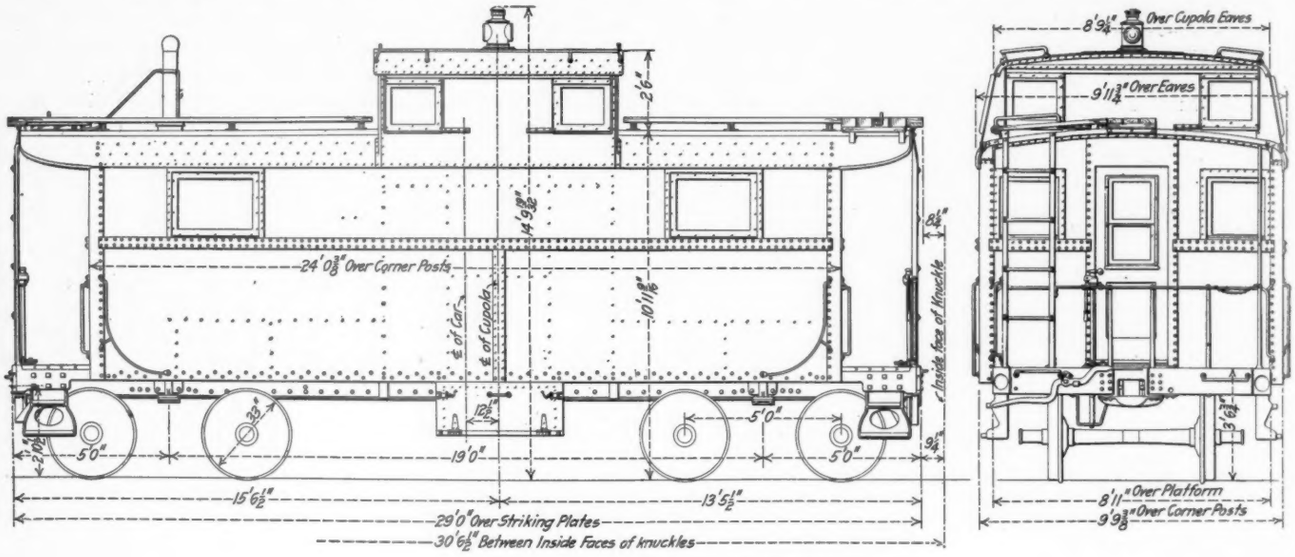
The side sill, or side floor supporting member, is a 4 in. by 4 in. by ⅜ in. angle, with the back turned outward. This angle is continuous between the side and end sill connecting castings, which form the side supports of the platforms and connect the side sills, the diagonal braces and the end sills, and are shaped at the outer ends to form corner push-hole pockets. The diagonal braces are of U-shaped section, 6 in. wide and ⅜ in. thick, with 3 in. flanges turned downward. They are flattened out at either end and riveted to the top flange of the center sills and the side and end sill connection.

The end sill is also a pressed U-shaped section, which is fastened to the striking plate and the side and end sill connecting casting. The entire underframe, with the exception of the platform, is covered with ¼ in. steel plate, which extends from the center sill cover plate to the side sill angle. The brake rigging supports and the equipment box, which is 4 ft. long, 23 in. deep, and 21⅞ in. high, are secured to this floor sheet. The equipment box is made of ⅛ in. sheets, with a door at the front which swings down.

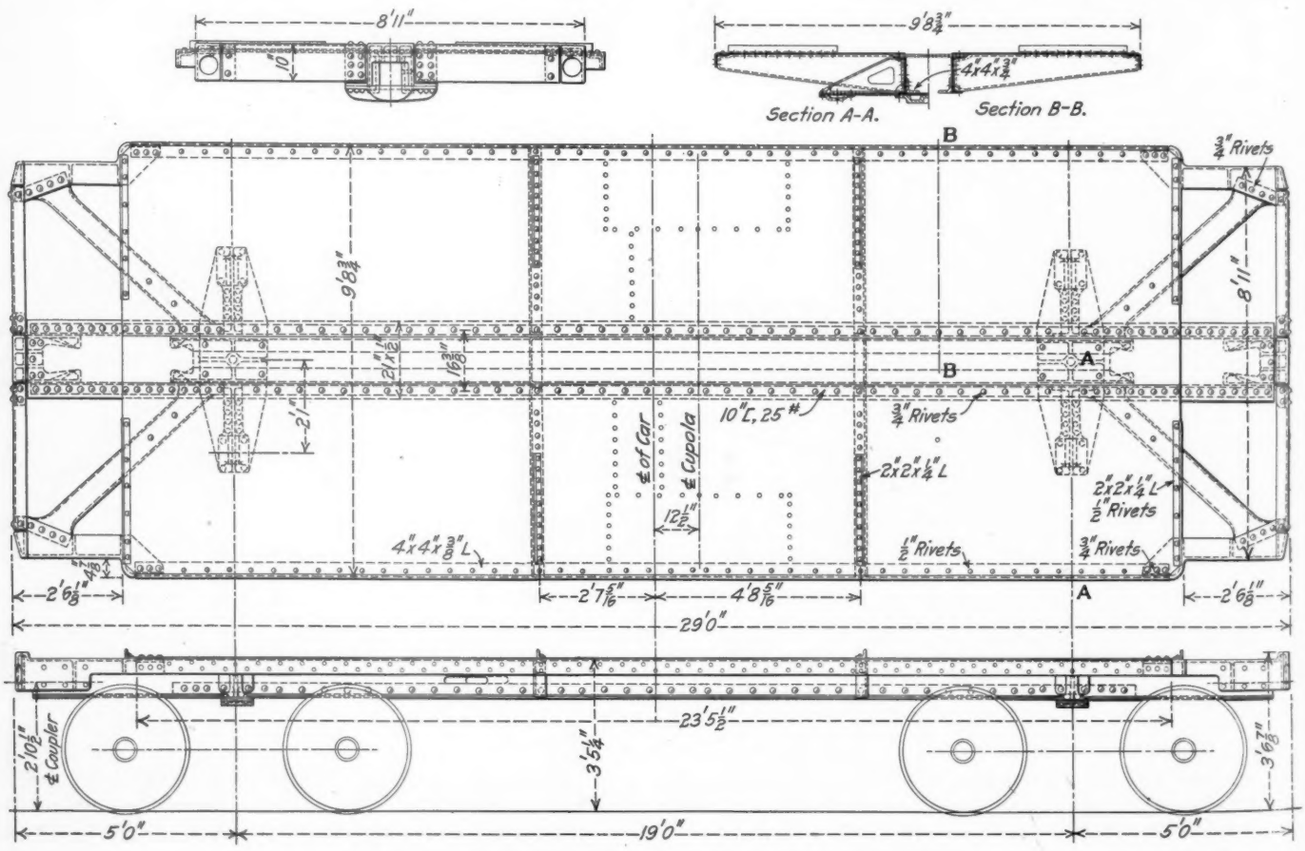
SUPERSTRUCTURE

There are no posts used in the superstructure, the transverse stiffness being obtained through the end construction and bulk-

heads, which form the sides of the lockers at the center of the car. These bulkheads are so located that they are directly above and riveted to the diaphragms of the underframe, thus forming four stiffeners at the center of the car each 3 ft. deep. The sides and ends of the car are made up of ⅛ in. sheets and a 4 in. by ½ in. belt rail. The bottom panel is composed of two sheets, joined on the center line of the cupola by a butt strip, and butting against the top side sheets beneath the belt rail, which is 4 ft. 2 in. from the bottom of the side sill angle. The top panel is composed of three sheets, which are connected by the window frames. At the corners, the side and end sheets are connected by a 3/16 in. cover plate, which acts as a corner post. The end construction is of the same general design, the sheets being fastened to the underframe by a 2 in. by 2 in. by ¼ in. angle, as well as riveted beneath the corner cover plate, the belt rail and the end door frame. The end is further supported by two 4 in. channels, which act as door posts. These channels are fastened at the bottom to a cast steel threshold plate and the underframe, while at the top they are secured to the roof sheets.



Elevations of the Pennsylvania Steel Caboose

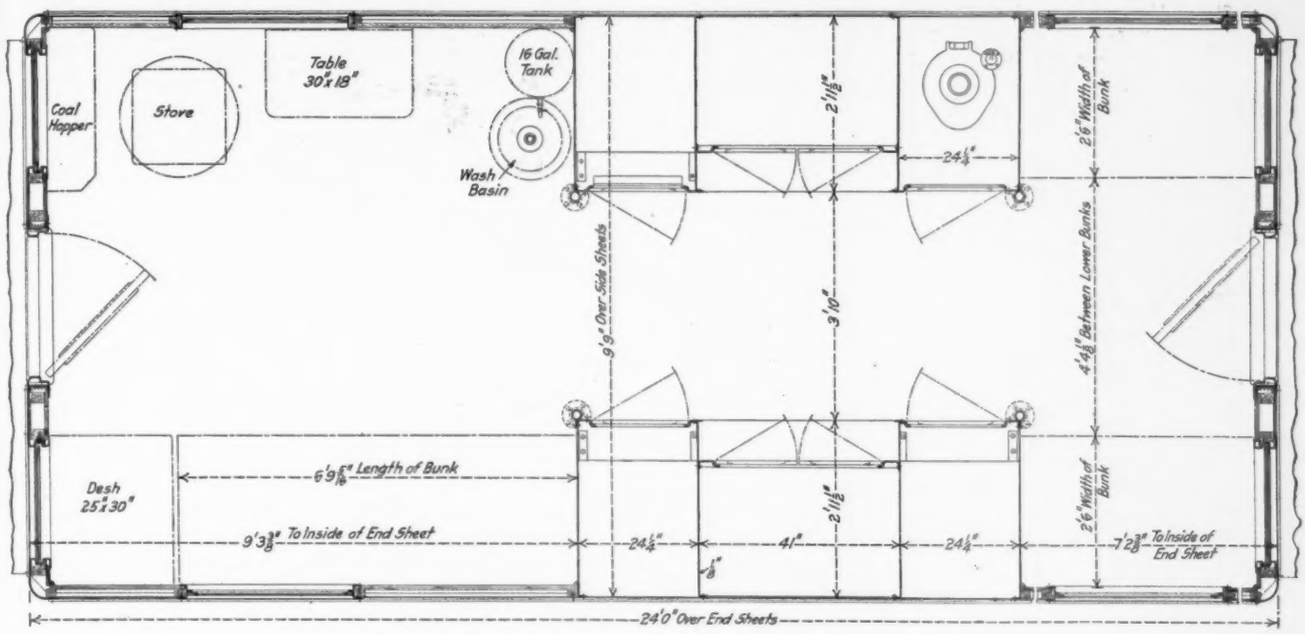


Underframe Construction Used on the Pennsylvania Steel Caboose

On the inside of the belt rail, and at the eaves, extending from

end sheet to bulkhead, is a U-shaped section, which stiffens the sides of the car at these points and also provides a means of securing nailing strips for the support of the lining.

The side window frames, which are riveted to the outside of the side sheets, are 3/16 in. thick. A ½ in. by 3/16 in. filler extends along the top of the side sheets, between the window frames, so that it is possible to extend them up under the roof sheets, making the construction waterproof and at the same time forming a straight surface to which the roof sheets can be attached.

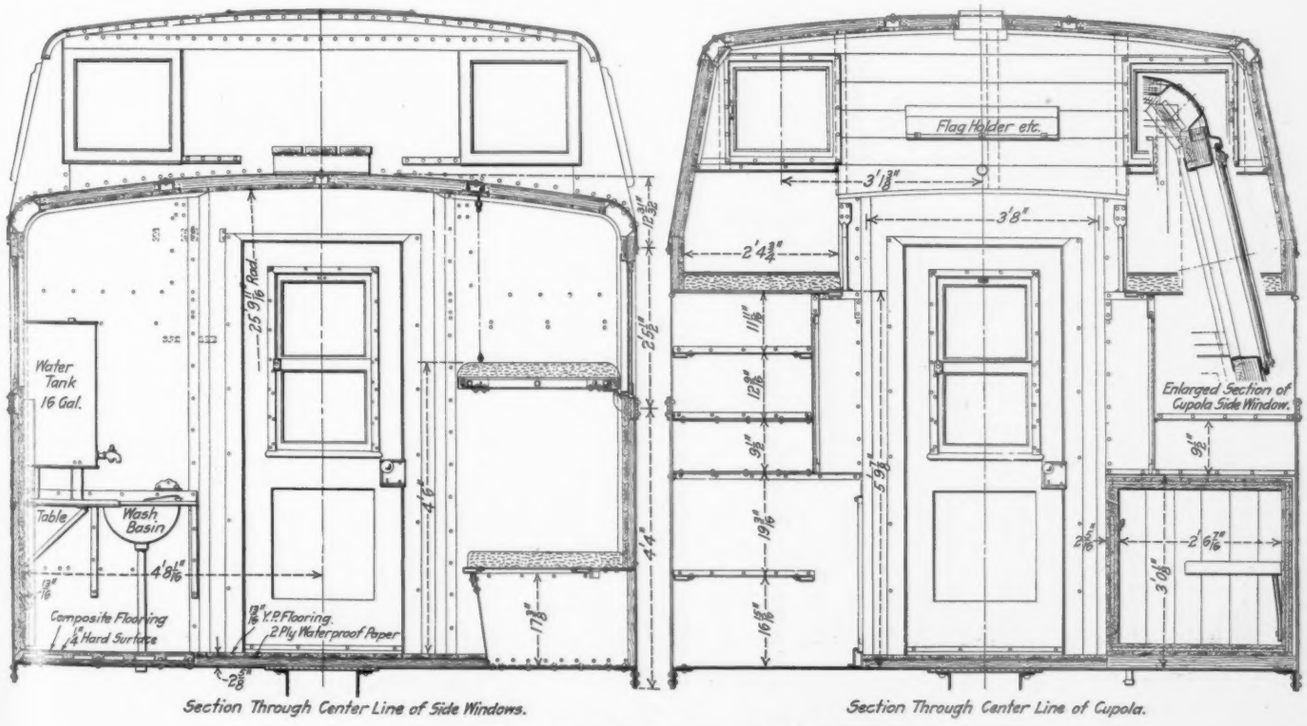


Floor Plan Showing the Location of the Different Interior Fittings

rail being incorporated with the eaves, while the window sill forms the bottom guide. This construction is such that when the window is pushed up against the end projection strip it forms a weathertight construction. The object in placing the windows outside is to leave the interior smooth. The sides of the cupola are inclined towards the center line of the car to allow for tunnel clearance.

ROOF

The roof sheets, which are 3/32 in. thick, extend lengthwise of

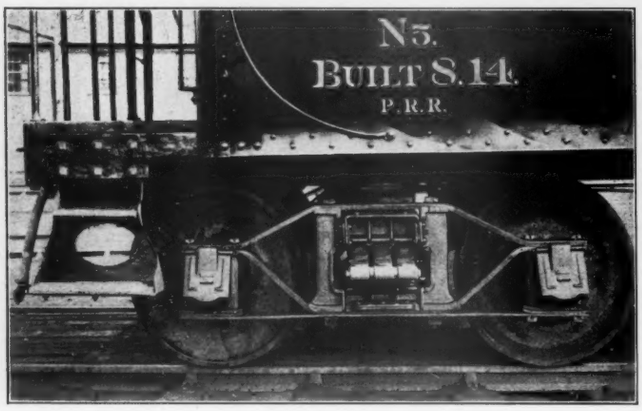


Cross Sections Through the Pennsylvania Caboose

The cupola extends 2 ft. 6 in. above the body of the car and is of the same general type of construction. The side and end windows of the cupola are all hung on the outside, a top guide the car in three panels, two of which, forming side panels, extend down over the sides of the car and fasten to the side sheets and eaves; a central panel, which overlaps the two side panels,

is secured with ¼ in. rivets spaced 1½ in. apart. Tar paper is placed between the lap of the center and side sheets, to insure a watertight joint. The main roof is supported by U-shaped purlins, which extend from the end sheets of the car to the cupola end sheets. The cupola roof is of the same construction. These purlins answer the double purpose of supporting the roof and providing a means of securing nailing strips for the ceiling.

The main roof extends over the platform 2 ft. 2½ in., and has a 2 in. by 2 in. by ¼ in. angle extending around the edge, which

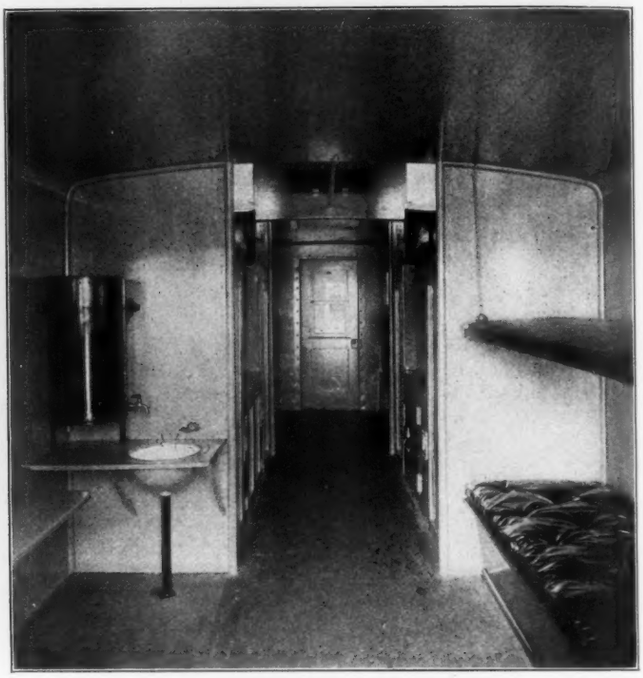


Platform Arrangement and Truck of the Pennsylvania Steel Caboose

lends stiffness to the structure and also acts as a weather strip for leading the water away from above the platform.

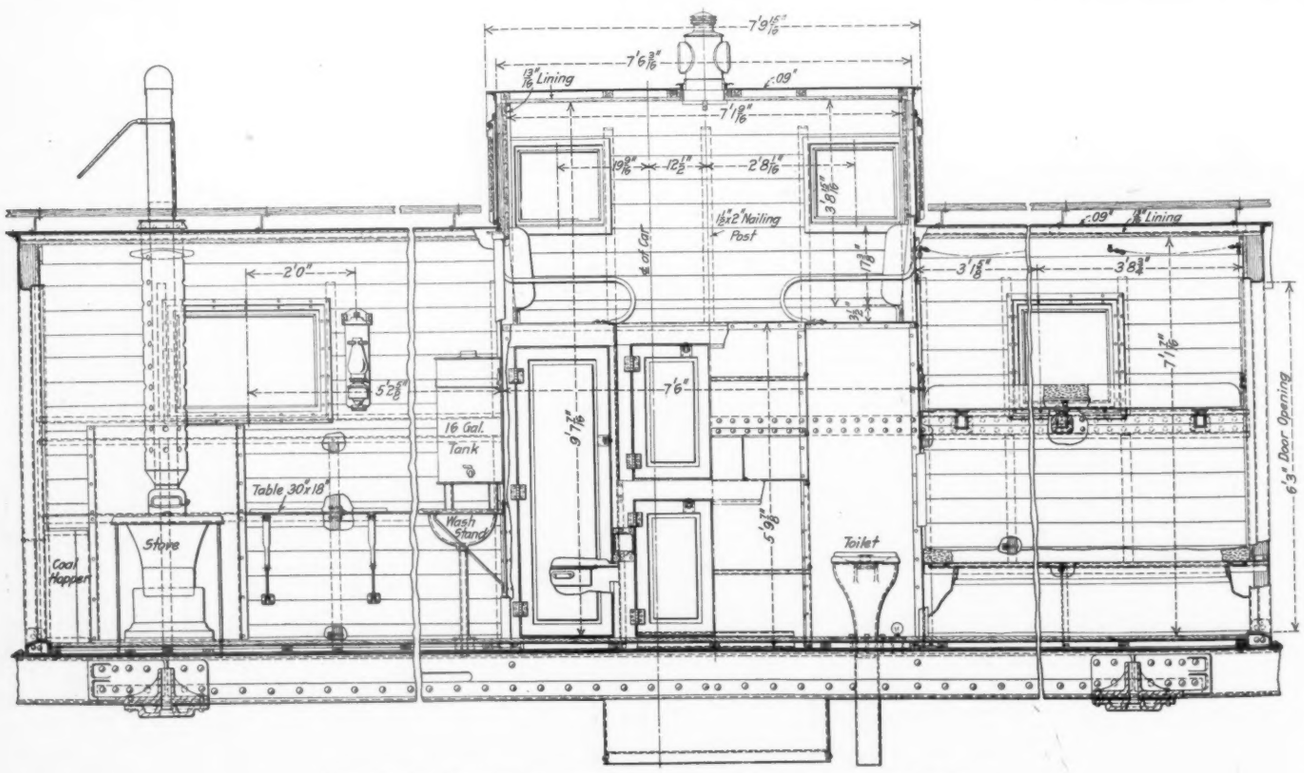
INTERIOR ARRANGEMENT

Convenience, comfort and safety were given great consideration in fitting up the inside. The car is equipped with a stove for heating and cooking purposes, a drop table, water cooler, washstand, refrigerator, desk and hopper, as well as lockers, drawers and cupboards for the men's personal belongings. Three pairs of bunks, upper and lower, are located along the sides, one at the stove end and two at the opposite end. The lower bunks are of a box type, 6 ft. 10 in. long and 2 ft. 5 in. wide, and are arranged for the storing of equipment necessary to the car in the bottom.



Interior of the Pennsylvania Caboose

The upper bunks, which are of the same dimensions, are attached to the belt rail by means of a cast steel hinge bracket, and when not required may be lowered and used as a back for the lower bunk when used as a seat. The upper bunks, when raised, are held in position by chains secured to the roof purlins, and hooked

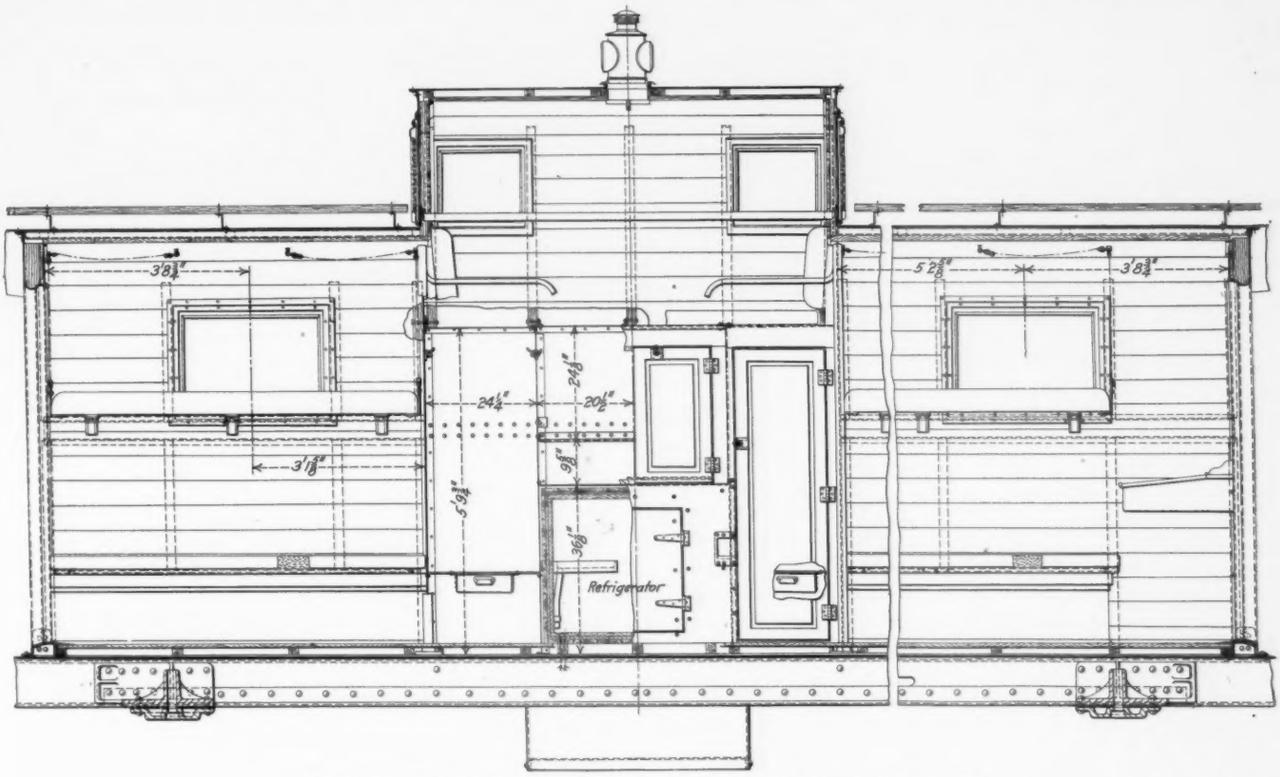


Longitudinal Section Showing Arrangement of One Side of the Caboose

to the side of the bunk frame, which is composed of 1¾ in. by 1¾ in. by ¼ in. angles, to which wooden nailing strips are secured for tacking down the canvas top. Including cupola seats, the car has sleeping facilities for eight men, the cupola seats being the same width and length as the bunks.

The lockers, which are located between the bulkheads and the lower cupola seats, contain the refrigerator in the lower center section, on the side opposite the stove and the hopper in one of the end lockers on the other side. The arrangement is such that there is ample room for dishes, food, lamps, oil and waste. All locker doors, drawers, shelves, etc., are 1/16 in. thick.

The side and end windows are above the belt rail, so that the light is not cut off when the upper bunk is raised. The side windows are fixed, while those at the end, including the end door windows, may be dropped. All locks or catches, with the exception of the refrigerator door lock, are flush, thus eliminating projections against which a man might be thrown by a sudden lurch of the car. The cupola is also equipped with a safety rail, extending between the end sheets of the cupola on the center line of the car, which is of convenience as a handhold.



Longitudinal Section Showing Arrangement of One Side of the Caboose

TRUCKS

The car is equipped with specially designed arch bar trucks of 5 ft. wheelbase, having axles with 3¾ in. by 7 in. journals. The usual column castings are replaced by a malleable casting which serves as a column casting, brake hanger support, spring seat, and spring plank extension. The bolster is of the inverted U-shaped type, with malleable iron stiffening castings, spring seats and bolster guides. The springs are full elliptical, 34 in. long and there are three in each group. The spring plank is U-shaped, ⅜ in. thick and 8 in. wide, with 1½ in. vertical legs turned upward. It extends across the truck 4⅝ in. beyond the center line of the arch bars, and is flattened at either end and bolted to the bolster guide spring seat and brake hanger support.

BATTLESHIP BOILERS.—The boilers of the battleship Nevada, just launched are to carry 295 lb. gage pressure. Oil-fired Yarrow type boilers will be used.—*Power.*

WOODEN CARS IN FREIGHT TRAINS*

BY G. E. SMART
Master Car Builder, Intercolonial Railway, Moncton, N. B.

A few years ago the 30-ton all-wood freight car was considered standard, but since the introduction of steel in car building it has replaced wood and today we have all-steel coal cars, all-steel box cars lined with wood, and steel underframe cars of all classes of 40 and 50 tons, and a few even of 75 tons capacity. There are, however, a large number of wooden underframe cars still in service, and the question is, what can be done to make this class of car safe to be handled in long trains and meet the severe usage that they receive in yard switching?

The draft gear problem is certainly the most important. The annual cost of repairs to cars that are damaged through draft gear failures, and loss and damage claims resulting therefrom exceed the cost of all other repairs made to freight car equipment. What are the causes of these failures?

First, the introduction of heavier power and longer trains; second, the placing of light and heavy cars together in trains; third, rough switching of cars in yards.

With regard to the first and second causes, the tractive effort of locomotives has increased during the last few years from 20,000 lb. to about 45,000 lb. for locomotives in general use in Canada, and in the 2-10-2 type used on United States roads to 84,000 lb. In addition, there are in use in certain sections of the country, locomotives of the Mallet type, with a tractive effort of 110,000 to 120,000 lb. The average number of cars hauled in a train a few years ago was 25, the train being approximately 1,000 ft. long. Today ordinary trains are composed of 60 to 100 cars, and a train of 100 cars would be approximately 4,000 ft., or about three-fourths of a mile long. What chance has a wood frame car under the conditions as they exist today on the front end of such a train? If a car of this type were to be traced from the time it leaves the terminal it would be found that it was necessary to remove parts of the load quite often,

*From a paper read before the Canadian Railway Club, Montreal, Que., October 13, 1914.

which, beside the expense of repairs results in delay to freight en route, and is the cause of many damage claims.

The solution of the problem does not lie altogether in the physical characteristics of the car or entirely in the mechanical department. The operating officers should co-operate with the mechanical department in reducing the freight car repairs by arranging as far as possible that cars with all-steel construction or with steel underframes, or those with steel center sills be placed in the front end of the trains. It is a fact that we find light capacity cars with wooden underframes or empty flat cars leaving the terminal on the head end of long trains, and in the majority of cases the cars are billed through and will not be set off between terminal points, unless set off on account of draft gear failure. This could be avoided if the cars were placed towards the rear of the train before leaving the terminal. There are railways which recognize the necessity of placing weak cars toward the rear of the train, and they provide cards stating that they must not be placed more than 15 cars from the caboose. This indicates that the car is in such a condition that it must be so located in the train, but is safe in ordinary service to be hauled to destination. If this is done delay and extra switching on account of draft gear failures would be eliminated, and it would not be necessary to move the lading.

The third cause, "Rough switching in yards" is a great factor in car repairs. There is no speed limit for switching in yards, nor are there any rules in force governing the speed of locomotives in switching service. If one were to confer with the car inspectors and obtain their opinion as to where most damage is done to cars, I think I am safe in saying that their answer would be in the switching yards, as their daily experience in inspecting cars immediately on arrival and after they have been switched in the yard will confirm this. This is only a small item as compared with actual damage started in the yard, which, through the cars being necessarily weakened thereby, is aggravated after leaving the terminal and results in many cases in the cars breaking down before reaching destination. A visit to a freight car yard will show that it is just a question of how fast the cars can be switched together, the speed that the cars are traveling is not considered, hence cars are found buckled up in yards and the draft gear pulled out and lying around.

There should be some speed limit in yards to prevent this destruction of equipment. The time lost in switching out bad order cars damaged in the yard and in taking them to the repair track would often offset the time gained by excessive speed used in switching. The cost of repairing these cars must also be considered, and the thousands of dollars of damage done to the contents of cars that are not set out for repairs.

What is the mechanical department doing today to overcome these troubles?

First, they are building steel frame cars to certain specifications with stronger types of draft gear.

Second, applying steel underframes or steel center sills and steel ends.

Third, applying steel draft arms to the wood center sills.

Fourth, applying heavier types of couplers and draft gear, and using friction draft gear.

The demands of modern railroading require the stopping of a high speed train in about two minutes and the draft gear is expected to absorb the shock. The air brake department can help to eliminate the strain on the draft gear by instructing the enginemen as to the proper method of handling the long trains. The principal thing is to control the slack to prevent it from running in or out harshly. Slack in draft gear cannot be prevented, as it is due to compression of the springs, and the heavier the locomotive and the longer the train, the greater the care that is required. Enginemen are instructed in the air brake instruction car how this should be done, but the general air brake inspector should see to it that the rules are followed out in actual service.

The vital question today before the car department is how to keep these wooden underframe cars in service. The majority of the railroads are destroying the 40,000-lb. cars, but the 60,000-lb. and 80,000-lb. cars that were built with wooden underframes and short draft timbers are not any stronger and cannot withstand the heavy service and severe yard conditions of today. Unless the operating department will assist in reducing the damage done to cars and thus reduce freight car repairs, and also keep the cars in service by marshalling this class of car on the rear end of the train, and exercising greater care in switching cars in the yard, the cost of freight car repairs will increase and the repair tracks will be full of bad order cars. The only other remedy is to spend money to apply steel center sills or steel draft arms, so arranged as to strengthen the present wooden center sills, and in addition to this reinforce the end of this class of cars. But the strongest car built cannot withstand the severe usage received in yard switching operations today.

ROCK ISLAND LUNCH COUNTER CAR

The accompanying photograph shows the interior arrangement at one end of a new combination lunch counter and dining car, just put into service by the Rock Island Lines on the "Californian" train, to operate between Dalhart, Tex., and Santa Rosa, N. M. One-half of the car is devoted to a lunch counter, with a seating capacity of 12. The chairs are stationary, revolving, and furnished with high backs, and the car is equipped to handle all orders quickly. The remainder of the car is devoted to the regulation dining car service, there

Interior of the Rock Island Lunch Counter Car

being six tables, three on one side, each with a seating capacity of four persons, and three on the other side, each with a seating capacity of two persons.

The car has been rebuilt at the Rock Island shops for the purpose of providing a service suitable to the conditions prevailing through the territory in which it will operate, where it is necessary to maintain a fast schedule and where eating houses are comparatively few. Dining facilities on this train are imperative, but the demand for ordinary dining car service is so limited that the service is expensive to maintain.

SHOP PRACTICE

AUTOGENOUS WELDING

The following is taken from a report presented by C. L. Dickert, assistant master mechanic, Central of Georgia, at the convention of the International Railway General Foremen's Association, held in Chicago, July 14-17:

We have the electric and oxy-acetylene plants installed at Macon shops. One of our greatest troubles is breaking in operators and holding them on the job after they have learned to handle the torch successfully. Each craft does the welding of metals that originate in their respective departments. A blacksmith of the right caliber would, in my opinion, be the right man to handle the welding, as he has the knowledge of heating metals, taking care of expansion and contraction, whether or not the metal is overheated, etc.

Electric Welding.—A field in which electric welding has proven very successful and profitable is that of welding flues to the back flue sheets. We have in service today over 90 locomotives with flues welded to the back flue sheet, making a total of about 27,000 flues, and we have our first engine to fail on

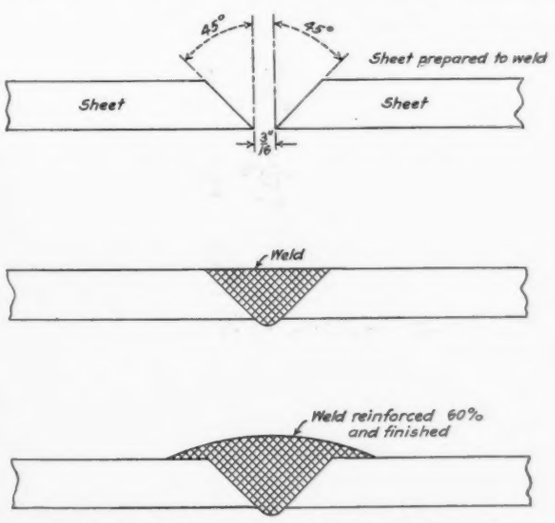


Fig. 1—Method of Welding Boiler Sheets by Electric Process

line of road with flues. We have, however, had some few flues to leak after being in service a short while, which was due to bad beads on the flues when they were welded in. If part of the bead is off, exposing the copper, it is very difficult to get a good weld.

Our first experiment on flue welding was tried out on an engine that was shopped for a new back flue sheet. The sheet was so badly worn and buckled that it was impossible to keep the flues tight. The flue beads and sheet were thoroughly cleaned with a sand blast, given a light working, and the flues were welded in. This engine was put back in service June 1, 1913, and to date has given no trouble from leaking. During this time a hydrostatic test was applied, and no leaks developed. This job was done at a cost of $14.68, where new flue sheet would have cost about $150, and the engine would have been held out of service for at least thirty days.

It is an easy matter to get the full life required by law out of a set of welded flues, thereby increasing the flue mileage, reducing the cost of maintenance, eliminating overtime in the roundhouse and on the line, and at the same time reducing the flue forces in the shop.

When new flues are to be welded, we apply them in the usual manner, viz.: Copper ferrules, roll, bead and prosser. A heavy bead is built up in welding the flues to the flue sheet. This leaves a rough finish. Some roads shape up the beads with a cutter, while others go over them with a beading tool to smooth them over. We find this is not necessary. The time welding 2 in. flues will average 14 per hour. In a few instances the operators have welded as high as 21 flues per hour.

Where welded flues are to be removed it only requires a few hours longer to cut off the beads. We found that flue sheet is in better condition than before welding in the flues, as the welding builds up the sheet around the flue holes to about the original thickness. We have a tool for facing off the rough surface after the flues are removed, making a good, clean sheet for applying new flues.

Welding in half side sheets and patches, repairing mud rings, etc., have proven very successful and profitable with the electric process, which will be seen from the following comparison between the old method of rivets and patch bolts.

A crack 3½ in. long developed in the mud ring corner, and was electric welded at a cost of $1.18. The old method of patching would have cost about $15, and engine would have been held out of service for at least three days. Two half side sheets welded in, 20 ft. of welding. Time 26 hours. Labor cost $10.37. Old method about $42. Two half side sheets and half door sheet, 26 ft. welding. Labor $13.90, old method about $61.50.

On new smoke box and extension front ends all butt joints are welded, saving about $3 on each job over the old way of straps and rivets. Quite a lot of welding with the electric outfit is being done on tank work. Corners are cut out and patches welded in, reinforcing the same as on boiler work, and we have no further trouble with leaks. Patches, half side sheets, half door sheets, and in fact all boiler plate work, in preparing for welding, are beveled to 45 deg., the two inner edges coming together, and sheets securely fastened with temporary bolts. A ripper 3/16 in. thick is run through, making a 3/16 in. opening on the inner side. The operator, when welding, welds from 3 to 4 inches flush with the sheet, and then goes back and reinforces the weld to about 60 per cent of thickness of plate. See Fig. 1.

Cracks in the side sheets that extend from one staybolt to another, are V'd out the same as preparing a patch, and the staybolts are removed and the holes welded up. Unless the rivets are loose to begin with, it is not necessary to remove them as they do not loosen up from welding.

While the electric welding of cast iron as a general proposition has not proven satisfactory, especially on parts that are under strain, we are successfully welding up cracks in smoke box doors and fronts.

Electric welding has proven very valuable and profitable to us in filling up worn links, link blocks, blade jaws, saddle pockets and cellar bolt holes in driving boxes; welding new notches in quadrants, worn places in frames caused by spring rigging wearing; building up piston fits to crossheads, rod ends and straps; in fact everything that is worn or broken that it is possible to reclaim at a profit. There is no limit to its usefulness, as we always find something new to be done.

Oxy-acetylene Welding.—Oxy-acetylene process of welding and cutting has passed the experimental stage, and has made a more rapid growth in the past few years in railroad work than all the preceding years combined. The Central of Georgia Shop at Macon is now being equipped with a strictly up-to-date plant, which is being installed by the Oxweld Railroad Service Company. The generator house, which is located a short distance from the main shop, consists of three rooms. In the first room

we have a 400-lb. total capacity generator. In the next room we have a twenty cylinder manifold, and the next room is used for supplies. The generator is duplex, having two generators—one on each side of a gas bell. In this way there is never any delay in charging the generator. The manifold works on the same principle, having ten 250 cu. ft. cylinders cut into line at a time.

The two gases are piped through the erecting, boiler and tank shops, stations being located at most convenient places to reach the work. In the erecting shop we have stations between every other pit, making it possible to reach any part of an engine

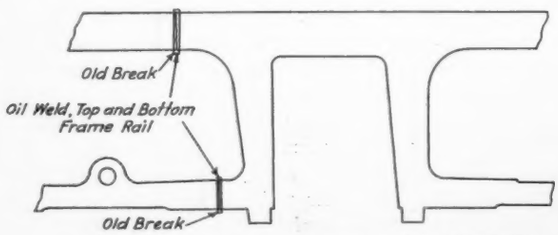

Old Break
Oil Weld, Top and Bottom Frame Rail
Old Break
In welds of this character, the frame is jacked open all we can get and wedge forced in as thick as we can get it - 5/32" allowed for expansion.

Fig. 2—Difficult Oil Weld, Top and Bottom Frame Rails

with a short length of hose. The stations through the boiler and tank shops have the same spacing.

We are installing the low pressure system, which means an acetylene pressure of less than one pound per square inch. The constant pressure obtained in the low pressure system is an assurance of a neutral cone on the blow pipes. The oxygen line carries 40 lb. pressure in the pipes, with proper adjustments at the blow pipe. The acetylene valve on blow pipe is opened wide, leaving only the oxygen valve to be adjusted.

Oxy-acetylene welding and cutting is indispensable in a railroad shop. In cutting it has the field to itself. The cutting, alone, is a paying proposition, saying nothing of its many advantages in welding over other methods. Our practice in removing fireboxes is to cut the fireboxes up into sections with the oxy-acctylene gas, and punch the sheets out. The average time in

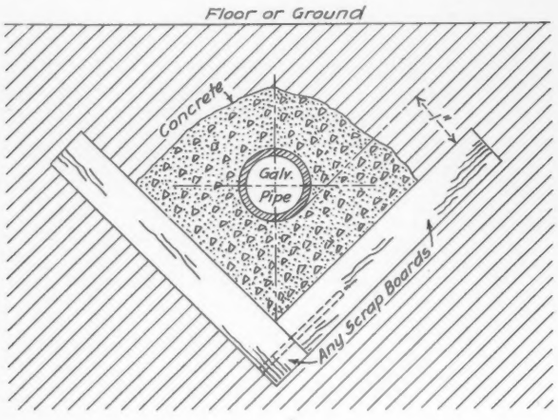


Fig. 3—Method of Laying Pipe for Oxy-Acetylene Systems

cutting out a firebox in this manner is five hours, thereby saving the breaking of the staybolts and radials. Following are some of the most important jobs that we have done in boiler department, and the life and results from the oxy-acetylene welding:

Half side sheets and half door sheet welded in a firebox May 15, 1912. No trouble, still good.

Half door sheet welded in, June 28, 1912. No trouble, still good.

Half door sheet and patch in side sheet, welded January 18, 1912. Patch in side sheet failed March 10, 1913.

Four patches welded in outside firebox sheets where spring gib wore holes in boiler, October 31, 1912. These patches are still good. Never gave any trouble.

Half door sheet, extending 8 in. on each side sheet, welded in, November 25, 1911. Still good, no trouble.

Half side sheet 10 ft. 4 in. long, welded in, November 4, 1912. About 2 in. of this weld gave way. Trouble stopped by caulking.

Half side sheets and half door sheet welded in the firebox, February 27, 1912. The weld on right side sheet failed May 6, 1912, had to be patched. Balance of job—good.

Patches at front mud ring corners welded in, December 24, 1912. No trouble, still good.

New collar welded in two-thirds of fire door hole, November 12, 1912. No trouble, still good.

Half door sheet welded in, May 26, 1913. No trouble, still good.

Two cracks welded in top knuckle of back flue sheet flange, September 30, 1911. Weld held until firebox was removed in November, 1913.

Two patches welded on bottom corners of back head, March, 1913. Patch failed on right side in August, 1913. Repeated attempts were made to weld this by electric process but failed, and finally had to resort to patch bolt patch.

The cutting torch is used very extensively in the boiler department. All patches, all side sheets, all fire boxes, and all holes in

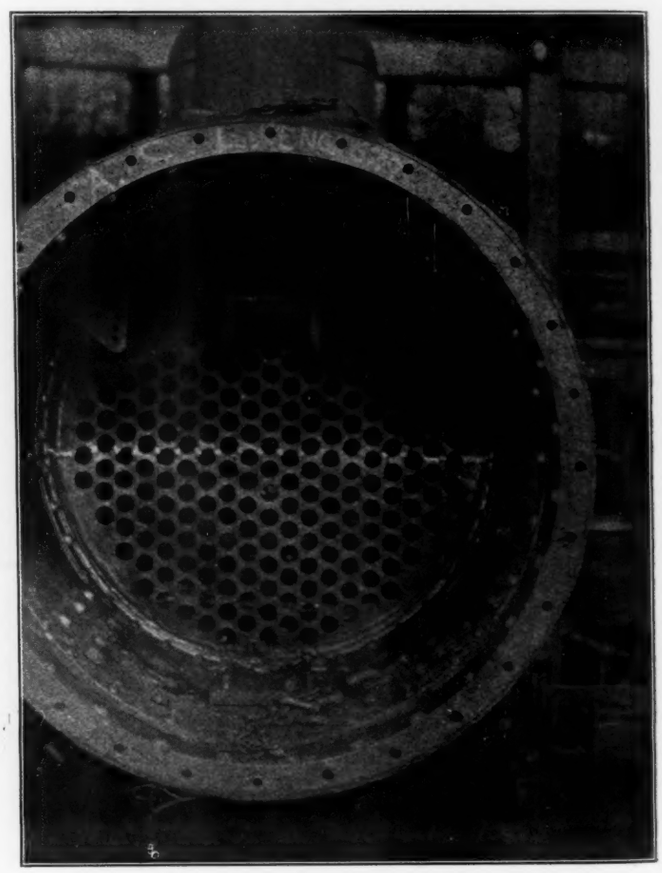


Fig. 4—Front Tube Sheet Repaired by the Oxy-Acetylene Process

the cab, cab and running boards, are cut with the oxy-acetylene torch.

Thermit Welding.—The welds we have made with thermit have proved very satisfactory. Have quite a number of frames welded that have been in service several years. Some few welds failed in service, the percentage of failures being very low.

Oil Welding.—Oil welding of locomotive frames has been the practice at the Macon shops for the past two years. Quite a number of welds have been made during this time which have proven very successful. The success of oil welding, like all other methods of frame welding, depends largely on allowances made for expansion and contraction. The most difficult job we have found is shown in Fig. 2 where top and bottom rails are broken. We have made two welds of this nature, one of which failed and the other still in service.

There is but little expense attached to this method of welding.

The outfit consists of small oil burner, oil tank and two small battering rams. The entire outfit is mounted on four wheel truck which is easily handled around the shop. The material used, crude oil, fire brick and fire clay, costs about $2. The balance of the expense is labor, which amounts to about $6, making a total cost for preparing and welding frames, an average of $8. In preparing a frame for welding we cut out straight through the frame where it is broken, with the acetylene torch, trimming off afterwards with a hammer and chisel to get rid of the scale and burnt metal made with the torch. The frame is then jacked apart and good hammered iron inserted, leaving projection of ½ in. all around. A furnace is built around the frame with fire brick, leaving an opening for the burner which

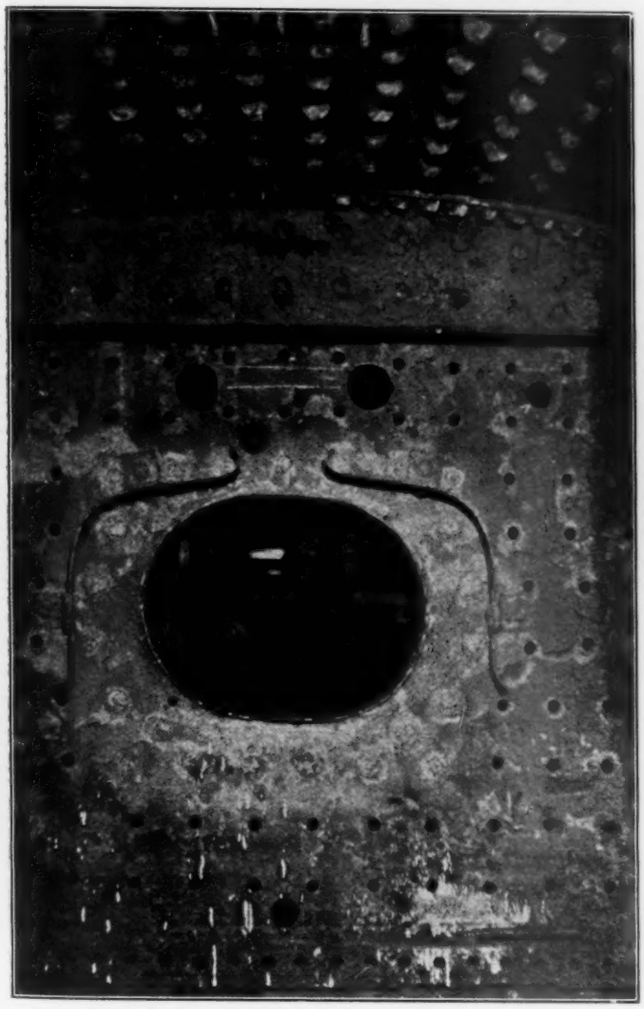


Fig. 5—Three-Fourths of Door Sheet Removed

is placed within a few inches of the opening. When the frame is brought close to the welding heat, the oil is cut down, allowing the heat to soak thoroughly through frame. The oil is then gradually increased until the frame reaches a welding heat, and the jacks are removed, letting pressure come on the weld before the furnace is knocked down. The furnace is then knocked down, and hammers and battering rams are used for hammering up the dutchman, leaving the frame slightly reinforced. While the heat is on all surplus metal is chipped off.

We have found this method of welding to be the most economical, just as good as any, and better than some methods of heavy frame welding that we tried.

Welding Practice on the Atlantic Coast Line.—For all heavy work, such as locomotive frames, thermit is used. For light work, such as boiler and tank sheets, steel car parts, small broken castings, iron, steel, brass, aluminum, etc., the oxy-acetylene process is used. With thermit perfect welds on locomotive frames in almost all localities have been made. The average cost for making thermit welds is from $15 to $20, not including the removal or application of parts necessary to make the weld.

The cutting torch is used for a variety of operations. The welding torch is used to repair broken cylinders, all kinds of boiler work, broken steam and exhaust pipes, air pump heads, gear wheels, pulleys, built up the inside lap of slide valves, malleable iron parts for cars, parts for air drill, cast steel parts of various shapes, brass parts such as lubricators, brass and aluminum castings, and in fact there are very few parts which are usually found about a railroad shop which cannot be repaired. Autogenous welding has very materially reduced the cost of repairs, and in addition the engines are not kept out of service near so long as they would be had it been necessary to make repairs in the old way. In the boiler shop, alone, the oxy-acetylene process has reduced the labor cost 20 per cent or 25 per cent.

Welding Practices on the Delaware & Hudson.—That road is making a very considerable saving with the electric welding, and discontinuing its use would mean the manufacture of a great many new parts that are now built up and reclaimed.

The oxy-acetylene system was installed last year by the Ox-

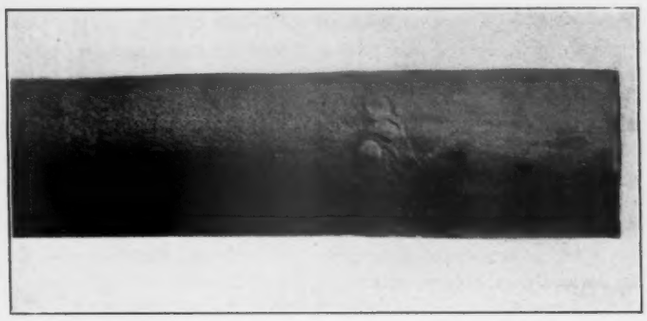


Fig. 6—Copper Safe End on Charcoal Iron Tube

weld Railroad Supply Company. The class of work done includes the welding of various castings when defective, building up of the worn surfaces on the heavier castings (as this is a surer process than the electrical) welding of engine frames, which are not always successful, welding engine truck frames and cradles, all frame braces and brackets, plugging holes in heavy motion work parts, reclaiming nearly all tender bolsters, guides and pedestals, cracked locomotive bells, etc. On boiler work all firebox door sheets are welded when they join in the fire door hole, patches to boilers are applied, and sections to flue sheets and broken bridges are welded. In cutting, this system is indispensable. As to cost the total saving shows a considerable balance in favor of autogenous welding.

Some of the features to be guarded against with this system, especially if the shop is piped, are leaky joints in pipes, hose, fittings and connections. Keep the water bottles filled to prevent explosions, instruct the operators as to the use and abuse of torches, and use every means to consume the least gas, all of which rapidly runs up the expense.

The Goldsmith thermit weld system is used for welding nearly all engine frames, this having proved the most desirable. The points to watch to make a successful weld are: Watch and have the surface hard and clean, as slag does not make a good weld. When welding a frame with two rails, that is, a top and bottom section, heat the section which is opposite the break to a red heat before pouring, so as to eliminate the contraction in the welded frame. Enlarge the weld as far as possible to insure strength. This method is used also in welding broken spokes in steel driving wheels. However, it is necessary to return and

shim the rim of wheel due to contraction, unless the entire section is cut out, rim and all, and raised about ¼ in., the amount of the shrinkage on wheels. This pays on wheels with retaining rings.

Welding Practice on the Chicago, Milwaukee & St. Paul.—In regard to the welding of locomotive frames at the Dubuque Shops, Iowa, with crude oil: Over 200 welds successful on all parts of frames have been made in the last 5 years. If the frame is broken through the back or the brace, or the leg, the break is drawn together with clamps and the exact length is taken. Then a 2 in. hole is drilled down through the center of the break, and an air power hack saw saws out the broken parts, leaving a straight surface. Then the frame is expanded about ⅞ of an inch with screw jacks, and a tin template is made to fit the opening, and a block is machined to the template, making a nice fit. The block is driven to place ready for welding. A furnace is then built allowing 2½ in. from each side of the block, and 3½ in. on the top and bottom, and extending out about 13 in. from the frame. The burner is then started, and in about two hours on a section 5 in. x 6½ in. the frame will be ready to weld, which is done by dropping out the jack, allowing the pressure to come forward and make a perfect butt weld. The burner is quickly removed, and small battering rams are used to weld up the sides. If the frame should not come to the desired length a heavy battering ram is used, and with a few blows the frame is brought to the proper length.

One of the particular points in the frame welding is to be sure to get the grain of iron placed the proper way in the frame. Also the average cost in welding these frames is about $7.50 for blacksmith work and $8 for machinist's work, making a total of $15.50.

Conclusions.—Experience now indicates that the two methods, electric and oxy-acetylene welding, have advantages over each other in certain different operations. For welding flues to back flue sheet, filling in on caulking edges, reinforcing small corroded parts, or where it is important to confine the high temperature to as small an area as possible, due to contraction, the electric process is superior.

For large boiler patch work, new half or whole side sheets, long cracks, or in work where suitable provision for contraction can be readily provided, and in cutting or removing defective parts on old sheets, the oxy-acetylene excels. It is therefore clear that in large shops the installation and use of both methods is not only desirable, but an excellent paying proposition.

When the oxy-acetylene system is used precautions should be taken when pipe mains, valves, and fittings are first installed. An excellent method is to use galvanized pipe with all screwed connections soldered over, and leak gaskets at all flanged connections, after which the pipe mains are encased in concrete with small expense as outlined on Fig. 3. All valves should be lead seat and tipped which can be applied to ordinary globe valves.

The use of the apparatus and particularly the torch, requires, like everything else, some intelligence and experience to obtain the best results. The most important feature the operator must learn is to so manipulate his work as to avoid as far as possible excessive contraction of cooling parts. Welding of long vertical cracks or seams of firebox sheets can be nicely provided for by a small running stream of cold water each side of crack while the welding is in operation and the heating of sheets thereby confined to a very small space. Horizontal seams and cracks in fire boxes are best made before mud ring rivets are driven. In the application of firebox patches suitable provision for the contraction of cooling parts can be frequently provided by slightly dishing or cupping the new patch to be applied which is afterwards pulled in straight by nut and bolt before staybolts are applied.

In repairs to fire door cracks, experience strongly indicates, for back shop practice at least, better results are obtained by cutting out the cracks, replacing by patches. The welding in by oxy-acetylene of new full, or half side sheets, or strips from 12 in. to 24 in. high all round the bottom of throat sheet, outside sheets or wrapper sheets, and back head is a most decided success from many standpoints, including a first class permanent tight job, great economy of both labor and material as well as the saving of time over the old methods.

The Atlantic Coast Line has experienced most excellent success with boiler repairs made by the oxy-acetylene process at their Waycross, Ga., shops, including some very radical departures over the old method of repairs. Fig. 4 shows repairs to front flue sheet completed except reaming out flue holes where bridges were welded. Fig. 5 shows an engine after three-fourths of the fire door sheet has been removed for renewing. The portion of the old sheet removed was defective at the flanges where it was secured to the side sheets, along mud ring, and fire door cracks. It will be noted the good part of this fire door sheet where secured to crown sheet is retained.

Fig. 6 shows a copper safe end welded onto a charcoal iron flue which comprised one of a full set of flues so installed experimentally September, 1913, in a locomotive type of stationary boiler that previously had given a great amount of trouble due to pitting

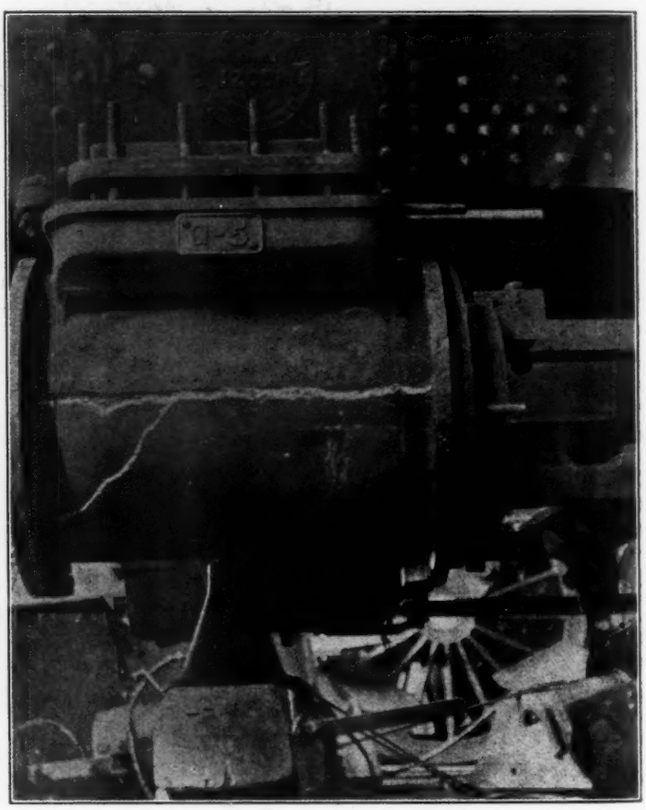


Fig. 7—Cracked Cylinder Repaired by an Oxy-Acetylene Weld

of flues just inside of back flue sheet. The trouble previously experienced has been completely eliminated, and boiler still in the same continual service without flue repairs. It is worthy of mention, that of this set of flues when applied to boiler, not one failure occurred from leak in weld during test or since, which proves the adaptability of oxy-acetylene welding of dissimilar metals. Fig. 7 shows a cylinder repaired by the oxy-acetylene process.

The thermit process of welding as applied to the railroad repair shop, particularly in its field of frame welding, maintains its advantage in the element of time, portableness in manipulation, simplicity of apparatus required and its convenience to the smaller outlying points of modern facilities. In the back shop after the engine is stripped, ordinary frame fractures are thermit welded in four and one half to six hours from start to pour. Special railroad thermit is now obtained already mixed with the proper proportions of one per cent nickel, one per cent pure metallic man-

ganese, and fifteen per cent low carbon boiler punchings, thus relieving the shop entirely from what previously was one of the most important features for best results.

Unless a very high quality of crude oil is available, kerosene is much more desirable for preheating, since crude oil, particularly of the heavier gravities, leaves a sooty deposit or film of carbon on the heated parts which prevents the hot thermit metal from coming in direct contact with the stock. In order to obtain perfectly sound welds with the thermit process, it is absolutely essential when the pour is made, that the parts to be welded be at least a bright red heat. The preheating should be done inside the mould, and in this way not only the parts to be welded are thoroughly heated, but also the interior of the mould as well.

The report was signed by C. L. Dickert, Chairman, C. of Ga.; R. B. Van Wormer, A. C. L.; C. M. Newman, A. C. L.; A. A. Masters, D. & H.; F. P. Miller, C. M. & St. P., and Wm. Hall, C. & N. W.

DISCUSSION

F. A. Byers, St. Louis & San Francisco, spoke of the splendid success obtained with the oxy-acetylene process at the new shops at Springfield. These shops are piped for oxygen and acetylene gas and equipped with 20 welders. All firebox side sheets are welded, whether quarters or halves are put in. The joints are sanded and chipped and the staybolts and rivets are put in after the weld is made. That road has made successful frame welds by making a double V on the frames and preheating them to above a cherry red. Two men weld at the same time, one on each side. There have only been two failures out of 77 frame welds. They have only been able to find one man who can weld cast iron with oxy-acetylene satisfactorily, making it so that it can be machined. In welding in flues, the sheets are sanded, the flues are rolled slightly and beaded before being welded. As a record, he stated that 360 flues were welded in three days and three nights by one man. As regards the welding of safe ends on flues, the acetylene method has been found more expensive than the other method. When welding in the flues the front ends are left loose, while the back ends are being welded in. In connection with his remarks, Mr. Byers submitted the accompanying table, showing the work done at the new shops of the Frisco during the past fiscal year.

Other members could not report as good success with frame welds with the oxy-acetylene process as did Mr. Byers. This was attributed to the workmanship more than the process. Mr. Lauer, of the Illinois Central at Memphis, spoke of the good results they had with welding cast iron with the oxy-acetylene process. It is necessary to thoroughly heat the object to a cherry red and keep it as near that temperature as possible while the weld is being made. Charcoal is used for the heating fuel and the broken parts are clamped together and V'd out for the weld. After it is welded the cylinder is allowed to cool slowly.

C. L. Dickert, C. of Ga., stated that the electric welding outfit would pay for itself by just welding flues alone. As regards patches, it was believed better to have a circular patch, or one with rounded corners, rather than a rectangular patch. Flat spots have been welded on wheels very satisfactorily by the electric method, Swedish iron being used, and, in some cases, wheel lathe chips for the flux. Worn holes in various parts of locomotives have been built up successfully with both the oxy-acetylene and the electric methods of welding.

As regards thermit welding, very good success was mentioned, the Chicago and North Western at Clinton having made 154 welds with only five failures. Three of the failures were attributed to poor moulds. Other roads reported very good results, and it was stated generally that extreme care must be taken in making the moulds correctly. One member stated that he had successfully welded a frame with two heats, although this was not believed to be good practice.

CONSUMPTION OF OXYGEN AND CARBIDE, FRISCO SHOPS, APRIL 1, 1913, TO JUNE 30, 1914, INCLUSIVE

	New shops		All other shops		Total	
Month	Oxygen Cu. ft.	Carbide Lb.	Oxygen Cu. ft.	Carbide Lb.	Oxygen Cu. ft.	Carbide Lb.
April (1913).....	6,600	550	.....	.....	6,600	550
May	12,500	1,100	.....	.....	12,500	1,100
June	13,400	1,200	.....	.....	13,400	1,200
July	22,400	2,500	.....	.....	22,400	2,500
August	26,600	2,500	.....	.....	26,600	2,500
September	37,850	5,200	4,700	800	42,550	6,000
October	67,550	6,500	10,800	800	78,350	7,300
November	57,600	8,100	38,300	5,100	95,900	13,200
December	60,000	5,600	53,500	6,955	113,500	12,555
January (1914)..	60,000	7,600	70,550	8,200	130,550	15,800
February	69,000	6,600	70,250	8,500	139,250	15,100
March	83,100	14,500	101,650	15,100	184,750	29,600
April	106,500	19,000	130,050	22,500	236,550	41,500
May	132,100	14,700	163,356	19,750	295,456	34,450
June	134,000	16,000	193,214	22,900	327,214	38,900
Total	889,200	111,650	836,370	110,605	1,725,560	222,255

SAVINGS BY INDIVIDUAL ITEMS—NUMBER OF PIECES, SPRINGFIELD NEW SHOPS, JULY 1, 1913, TO JUNE 30, 1914.

Parts	Pieces	Other methods	Oxy-Acetylene	Saving
Ashpans	637	$456.44	$904.34	$1,384.10
Brackets	391	858.22	332.04	466.13
Braces	661	2,562.42	1,066.34	1,496.08
Bolsters	13	231.57	24.87	206.70
Crossheads and pistons.....	254	3,873.68	572.37	3,301.31
Center castings	26	172.44	63.18	109.26
Center plates	2	98.50	6.44	92.06
Cylinders	23	6,105.88	89.21	1,516.67
Driving boxes	240	1,644.21	355.74	1,288.47
Drawbars	12	127.08	11.93	115.15
Driving wheels	3	133.58	36.13	97.45
Door collars and sheets.....	400	6,974.09	1,955.39	5,018.70
Deck castings	1	71.30	3.02	68.28
Equalizers	236	735.23	416.65	318.58
Engine frames	567	9,172.80	2,316.86	6,855.94
Front end ring.....	45	404.65	140.88	263.77
Firebox work, miscellaneous.....	3,017	20,733.12	10,210.40	10,522.72
Lubricators	3	105.00	3.54	101.46
Flue sheets	261	3,866.53	1,137.97	2,728.56
Shop machines	692	2,891.58	990.39	1,901.19
Main rod brasses	8	141.89	10.46	131.43
Miscellaneous repairs	473	1,455.36	560.21	895.15
Main rods	146	1,184.90	404.99	779.91
Miscellaneous parts	4,914	19,640.32	8,865.29	10,775.03
Oil boxes	531	1,790.64	678.95	1,011.69
Pedestals	626	2,080.05	742.78	1,337.27
Reverse lever strips.....	368	989.01	471.70	517.31
Rocker arms	100	788.53	181.24	607.29
Running boards	374	770.61	383.02	407.59
Steam chests	5	45.99	22.37	23.52
Steam pumps	10	190.00	19.95	170.05
Side sheets	495	31,512.10	3,918.31	27,593.69
Steam pipes	62	249.11	102.96	146.15
Truck boxes	113	437.71	201.51	236.20
Truck frames	14	531.58	65.80	465.78
Triple valves	2	23.00	2.48	20.52
Water columns	4	151.00	30.71	120.29
Total		$120,532.12	$37,340.42	$83,191.60

BLUEPRINT MARKING FLUID.—A useful and absolutely permanent marking fluid for writing in white on blueprints, may be made by taking a little soda ash and making a saturated water solution. This may be done as follows: Take a small bottle and nearly fill it with water; then add the soda ash, shaking the bottle from time to time, until the water will not dissolve any more of the crystals. Next strain the solution to remove the undissolved crystals and any dirt which may be present, and then pour it back into the bottle ready for use. This may be kept indefinitely. This solution may be applied to the blueprint with either a drawing pen or an ordinary writing pen. It works equally well in either case. Where the liquid is applied it bleaches the blue color of the print and leaves it a clear white. It sometimes happens that if the solution has been made too strong, a white powder forms on the lines when they are dry, but this may be brushed off. In such cases, if a little water is added to the bleaching solution there will not be any difficulty of this kind the next time it is used. If soda ash is not available, an efficient substitute can be prepared by using common baking soda. In this case, however, the lines are not quite so clear and sharp as those produced with the solution of soda ash. If it is desired to make colored lines, a preparation for this purpose may be made by adding ink to a solution prepared according to the preceding instructions. When this is done, the solution bleaches the blueprints so that the colored ink shows up well.—*Machinery.*

RECENT DEVELOPMENTS ON THE FRISCO

Work Checking System, Shop Schedules, Tools and Machinery, and Centralized Manufacture of Material

In connection with the other developments toward increased efficiency and economy which have taken place on the Frisco within the past year or two, a number of important and far-reaching improvements are being made in the mechanical department. While several of these are only fairly under way, the results obtained thus far justify describing and commenting on them at this time. The most important of these steps of progress will be considered briefly in the following article:

DATE SHEET—TEN-WHEEL ENGINE—FIFTEEN DAYS IN SHOP

Day Erecting Floor	Boiler Work	Bench Work	Machine Shop	Blacksmith Shop	Oxweld Plant
1—Engine in shop					
2—Engine stripped	Flues removed				
3—Parts cleaned and delivered					
5—Cylinders bored Valve chambers bored			Cylinder heads	Valve rods and stems Link work Piston rods	Valve rods and stems Link work Piston rods
6—			Cylinder bushings Valve bushings	Guides, yoke and blocks Misc. motion work Brake rigging Spring rigging Tumbling shaft	Crossheads
7—Cylinder bushings applied Valve bushings applied			Throttle Dry pipes Eccentrics and straps Tumbling shaft	Rods Engine truck work Crossheads	Spring rigging Engine truck work Guides and blocks Reverse levers Brake rigging
8—Valve chamber bored Throttle and dry pipe applied			Guides and blocks Engine truck work Spring rigging Brake work Rocker boxes Tumbling shaft boxes	Boiler brackets	Misc. motion work Misc. brackets Reach rod
9—Frames and cylinders lined Guide yoke up Cab fittings ready		Tumbling shaft boxes Rocker boxes Spring rigging	Steam chests Wheels	Frame braces	Rods Frames Frame braces
10—Tumbling shaft applied Rocker boxes applied Dry pipe and throttle applied Shoes and wedges laid off Frame braces applied Eccentric straps applied Center casting applied	Flues applied	Engine truck ready Guides and block ready	Crossheads Motion work Driving boxes		
11—Driving boxes fitted Frames and cylinders bolted Running board bracket up Spring rigging up	Staybolts applied Boiler work completed	Steam chests ready Crossheads Reverse levers	Shoes and wedges Steam pipes		
12—Boiler tested Steam chest applied Reverse lever applied Lagging applied Engine wheeled Steam pipes ready		Brake rigging Links	Rods and brasses Pistons		
13—Front end door and ring applied Cab and running boards applied Guides applied Shoes and wedges applied Motion work applied Pilot beam applied	Ash pan up	Main rods Side rods Pistons			
14—Brake cylinders applied Air pump applied Steam and exhaust pipe applied and tested Valves set Pilot applied Jacket applied Cab fittings applied Piston applied Grate rigging applied	Front end netting applied				
15—Brake rigging applied Rods applied Pipe work completed Engine trial tripped Engine painted					

Shop Schedule or Date Sheet for a Ten-Wheel Locomotive

WORK CHECKING

The locomotive and coach repair shops at Springfield—both the so-called new shops and the North shops—are administered on a day-work basis, and until recently no attempt has been made to check accurately the output of the individual workmen. Piece-work has automatically performed this function on roads on which it has been introduced, and at the same time has developed more adequate and efficient supervision. It was not deemed advisable, however, to introduce this system on the Frisco, although it was felt to be vitally necessary to develop some method whereby a careful check might be made of the itemized output, and in a constructive manner, so that the features which restricted the output, such as lack of proper knowledge and training on the part of the individual, unsuitable tools and machinery, defective material, poor design of parts, inadequate supervision, and other features of this sort, might be located and remedied in order to bring the efficiency to a maximum.

Under the old methods a record was kept by a time clerk of the time when the men started and left off work in the morn-

ing, at noon and at night. The actual account against which the time was charged was based largely on the workman's statement or upon an approximation by the timekeeper. As a result the times charged against different jobs were not found to be of sufficient accuracy to make it possible to intelligently check against abuses or defects such as those which have been mentioned above.

To overcome this the Frisco has adopted a rather unique and unusual scheme. Work checkers have been provided, each one

ST. LOUIS & SAN FRANCISCO RAILROAD
JAMES W. LUSK, W. G. BIXBY, W. B. BIDDLE, Receivers

DISTRIBUTION OF TIME

Name Keen W. J. No. 1523 Rate .41
Day Clerk Month Jan. 31 191 4

Time On	Time Off	Detail Description of Operation	Charge	No. Pcs.	Hours	Amount		
7 30	2 00	26 holes plugged. Step spring						
		hangers rep. 6 Patches Eng.	2003	24	5.5	2.25	✓	✓
2 00	3 00	Truck spring hangers. Sill and						
		dressed Eng.	769	4	1.	.41	✓	✓
3 00	4 30	Taking heats for 1503 S.O.	3377	2	1.5	.62	✓	✓
					8.	3.28		

Inspector Harry B. Smart. Foreman _____ Totals

Form Used by Work Checkers In Recording the Distribution of Time

of these looking after from 50 to 100 workmen, depending on the class of work and the department in which they are employed. There are two of these checkers in the erecting shop at the Springfield new shops, three in the machine shop, one in the blacksmith shop, two in the boiler shop and one in the tank and cab shop. These men constantly observe the progress of the work in the department which they serve, but have nothing to do with the distribution of the work. The checker has a card for each workman, similar to the one which is reproduced in the illustration, on which he enters in detail the operations which are performed, noting the times at which the work was commenced and completed and the engine or shop order to which each job is charged. These cards are 5½ in. by 8 in. in size. In the illustration spaces have been left between the different items in order to preserve a neat appearance in reducing the size of the form; this is not done in actual practice.

The checkers were selected from among the best of the mechanics in each department, and the training which they receive in following up the work will fit them admirably for positions as foremen, if such openings occur. It should be understood that these men check the quality of the work and accuracy of workmanship, as well as the time of performing it. They are paid practically the same as lead men, which is at a somewhat higher rate than the standard for first-class mechanics. In all cases, in making suggestions or changes, they work through the foremen.

Among the most important advantages of the time checking system as it has been developed thus far, are the following: (a) The recording of the detailed progress of the work, thus making the work of supervision less burdensome for the shop superintendent and general foreman. (b) The detection of waste of time and effort at its occurrence, thus enabling the foreman to promptly take the matter in hand, eliminate delays and reduce the cost of performing the work. (c) Absolute accuracy of the charges to the various accounts or to individual locomotives or shop orders, thus making possible a correct analysis of expenditures. (d) Cost data, which permits comparisons to be made and weaknesses to be located which may be corrected by improving the facilities or methods employed or by rearranging the force.

Much has been published in the past concerning the best methods of comparing the efficiency of one shop with another, the great difficulty being to define and decide on a standard unit of measurement. The value of the comparisons of a shop or a department as a whole on the basis of such units as have been suggested is questionable as far as it concerns the accurate detection of weaknesses or the relative value of different practices or methods. The most logical way of detecting lost motion or effort, and of eliminating it, is to study each operation in detail and make sure that it is the best and cannot be improved upon. The provision of work checkers on the Frisco and the way in which their efforts are being utilized is successfully accomplishing this and in very greatly increasing the efficiency of the departments and the shop as a whole in a way which must

Boxes of Surplus Tools Which Were Gathered Up and Returned to Stock

ROUTING CARD

Engine No. _____

REVERSE LEVER GANG

Operation	Date Expected	Date Comple'd
Rocker boxes and arms ready		
Reverse levers ready		
Reverse levers applied		
Reach rod ready		
Reach rod applied		
Throttle lever ready		
Throttle lever applied		

ROUTING CARD

Engine No. _____

LINK GANG

Operation	Date Expected	Date Comple'd
Tumbling shaft and boxes ready		
Links ready		
Links applied complete		
Walscharet gear ready		
Walscharet gear applied complete		

ROUTING CARD

Engine No. _____

STEAM PIPE GANG

Operation	Date Expected	Date Comple'd
Steam pipes removed		
Dry Pipes removed		
Throttle Box Removed		
Steam pipes applied		
Dry Pipes applied		
Throttle box applied		

Routing Cards Used by the Reverse Lever, Link and Steam Pipe Gangs

appeal to shop officers and foremen as being a most logical one.

WORK DESPATCHING

It seems strange that the railroads generally have been so slow in systematically planning the progress of the work through the shops in order to balance the strength of each of the various departments and to schedule the work of repairing the cars and locomotives in such a way that the entire staff may co-operate closely and effectively. The Chicago & North Western was one of the first roads to inaugurate such a system.* This was many years ago, and in spite of the fact that it was given wide publicity and that the whole scheme was most logical, other roads took it up very slowly and even today shop scheduling in its best form is used in a comparatively few shops. The methods which are being used on the Frisco are not essentially different in a general way from those introduced on other roads but are arranged to meet the special needs of the shops on that system.

Not only are the dates set for the completion of repairs to each locomotive, but the intermediate times in which each of the numerous operations must be finished are also designated. The general plan of this scheme is indicated on the accompanying form, which is known as a date sheet, and outlines the work which should be done on the various parts of the locomotive in

Boiler and Floor Work, No. 1

Engine number																								
Date in shop																								
Date expected out																								
Stripped except frames and cylinders																								
Flues removed																								
Frames and cylinders removed																								
Smoke box removed																								
Flue sheets removed																								
Door sheet removed																								
Cylinders bored																								
Valve chambers bored																								
Valve bushing in																								
Cylinder bushing in																								

Part of a Department Schedule Sheet for Boiler and Erecting Shop Work

each of the different departments for a ten-wheel engine which is to be overhauled in 15 days, or rather 150 hours, for arrangements have been made to adjust the schedule for any lengthening or shortening of the working hours per day. This particular sheet covers an ordinary overhauling where no special work, such as firebox sheets, new cylinders or new frames, is required. Repairs of this sort necessitate lengthening the schedule by a certain number of days, depending on the nature of the special work.

*American Engineer and Railroad Journal, February, 1904, page 58.

Similar date sheets have been prepared for every class of power and for every combination of repairs. As soon as a locomotive arrives at the shop a thorough inspection is made and a report is drawn up of the necessary repairs, from which it is possible to determine exactly what schedule should govern. This makes it possible to set the dates for the completion of each item and routing cards are filled in and issued to each gang or department foreman as a guide for handling the work. Sample

ROUTING SYSTEM---CHECK SHEET
ERECTING SHOP NO. 1

ENGINE NUMBER																								
	Date Expected																							
Engine in Shop	Date Compl't'd																							
	Delay																							
	Date Expected																							
Engine Stripped	Date Compl't'd																							
	Delay																							
	Date Expected																							
Parts Cleaned and Delivered	Date Compl't'd																							
	Delay																							
	Date Expected																							
Frames down	Date Compl't'd																							
	Delay																							
	Date Expected																							
Cylinders Bored	Date Compl't'd																							
	Delay																							
	Date Expected																							
Cylinders Bushed	Date Compl't'd																							
	Delay																							
	Date Expected																							
Frames up Complete	Date Compl't'd																							
	Delay																							
	Date Expected																							
Guides Lined	Date Compl't'd																							
	Delay																							
	Date Expected																							
Throttle Box in, Dome Closed	Date Compl't'd																							
	Delay																							
	Date Expected																							
Rocker Boxes and Tumbling Shafts up	Date Compl't'd																							
	Delay																							

Check or Delay Sheet Used With the Shop Schedule System

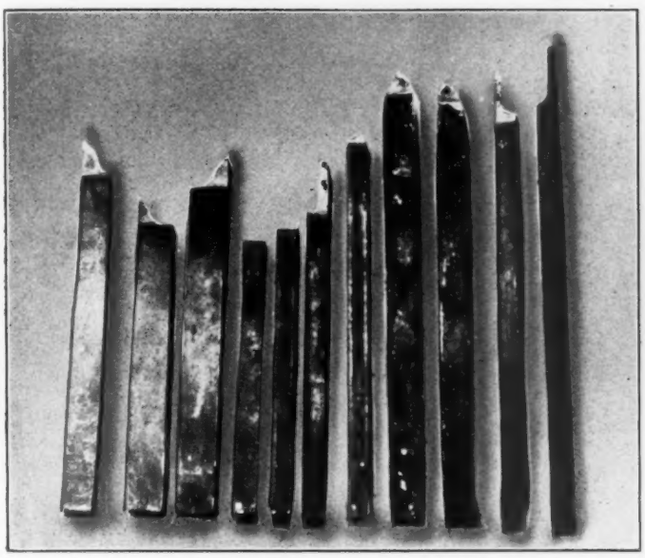
cards, such as used by the reverse lever gang, link gang and steam pipe gang, are reproduced in the illustrations.

For the use of the shop foreman who supervises the work of these gangs a special form is made out which applies particularly to the work of his department rather than to the handling of the locomotive as a whole, as on the large date sheets. A sample sheet of this sort for boiler work and the erecting department is reproduced in one of the illustrations.

The despatching system is handled by a foreman who practically becomes an assistant to the general foreman, relieving that officer to a great extent of the detailed supervision of the progress of repairs. He makes out the despatching sheets, timing the various operations to correspond with the date sheet for the type of engine and class of repairs. It is, of course, necessary for him to maintain a master sheet covering all of the engines in the shop and arranged in such a way that he can see that the work in the various departments is properly balanced, and from such reports of the progress of the work as he receives and enters on the master sheets he can determine practically at a glance whether the schedules are being lived up to. A daily delay report is prepared each evening showing just what operations are behind schedule, and provided with this the general foreman can go directly to the gang or department which is responsible for the delay and see that provision is made to overcome the deficiency.

This system, in addition to maintaining a balance between the

different departments, thus eliminating annoying and costly delays and securing a maximum output consistent with the force and facilities, has the additional not inconsiderable value of insuring prompt delivery of completed locomotives at a date determined well in advance, and thus enables the mechanical department officers to more intelligently handle the problem of the distribution of power. The shop schedule system to be a complete success must have the hearty support of all of the mechanical depart-



Eleven High Speed Tools Which Were Formerly Used With the Driving Wheel Lathe

ment officers and particularly of those higher officers having general supervision. If this condition does not obtain and the schedule is interfered with in order to give certain locomotives preferment, it would greatly hamper its usefulness and disorganize the entire shop.

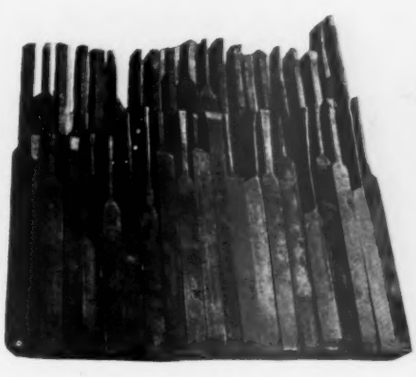
SHOP MACHINERY AND TOOLS

No one who has ever tried to use a dull axe, saw or chisel, and who has then taken time to put them in proper condition

Tool Holder and Tools Now Used With Driving Wheel Lathe

and has marveled at their greater effectiveness, will belittle the effort to see that all of the tools and machinery in a large locomotive or car repair shop are kept in first class condition. Possibly a given amount of energy and expense invested in work of this kind has resulted in more striking improvements in efficiency and output than any other one thing that has been advocated in the general campaign for improved shop production within the past few years. Many of the more progressive roads have been prompt to take advantage of this, although some of them have not as yet fully awakened to its possibilities. It was one of the first things which were done by the Frisco in its campaign for improved shop efficiency, and the results thus far have been startling, in that the maintenance expenses for shop machinery and tools have been surprisingly decreased, although this equipment is much improved and maintained in better condition.

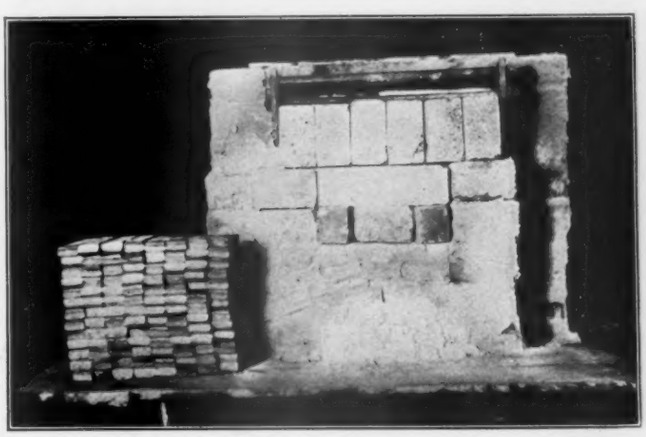
The problem was approached from several angles. It has in-



Forty-One Tools Formerly Used on Slotter

Tool Holder Now Used on Slotter

volved the appointment of a supervisor of tools, who has had general charge of the work, which in general includes the standardization and centralized manufacture of small tools and a systematic method of checking them and seeing that a complete and adequate supply, but not an over supply, is maintained at all points on the system. It includes also the strengthening and speeding up of machine tools and the providing of jigs and other apparatus for the accurate and rapid handling of the work. It should be noted, however, that in this latter respect the Frisco, particularly at the Springfield new shops, has not been in the rear ranks in the past. This is indicated by the shop kinks from that system which have been published in the *Railway Age Gazette, Mechanical Edition* from time to time, and particularly in the collection which appeared in July, 1913, submitted by J. C. Breckenfeld, at that



Special Furnace for Making All Lathe, Planer and Similar Tools for the System

time assistant machine shop foreman, who was awarded the first prize in the shop kink competition in which it was submitted. Mr. Breckenfeld is now supervisor of tools.

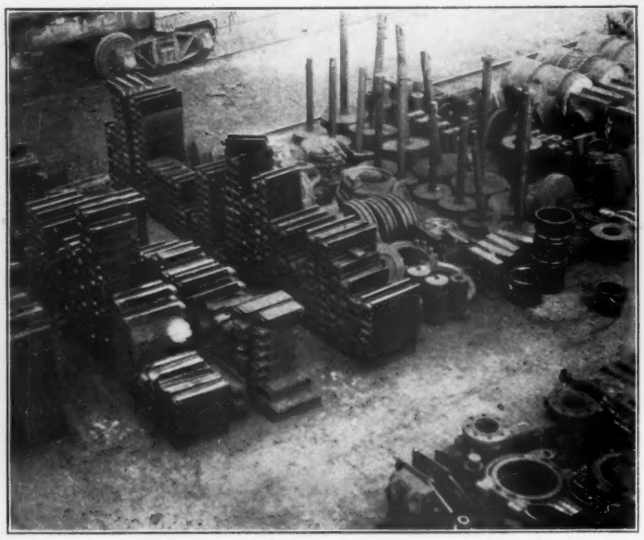
One of the first steps in the campaign was to make an absolutely correct inventory of all the machinery and tools on hand at the different shops and engine houses. This resulted in the collection of a large amount of obsolete tools, which have either

been worked over or sold as scrap, and also in the gathering up of surplus tools, which have been turned back into the stock and have been reissued as required. For instance, one of the illustrations shows a number of boxes filled with perfectly good tools, but which were in the nature of surplus stock and were turned over to the general store, the shops from which they were collected being given a credit of $2,005.41. This is only one of a number of similar lots of surplus tools which were gathered up.

Finished Tools Ready for Issuance to Shops

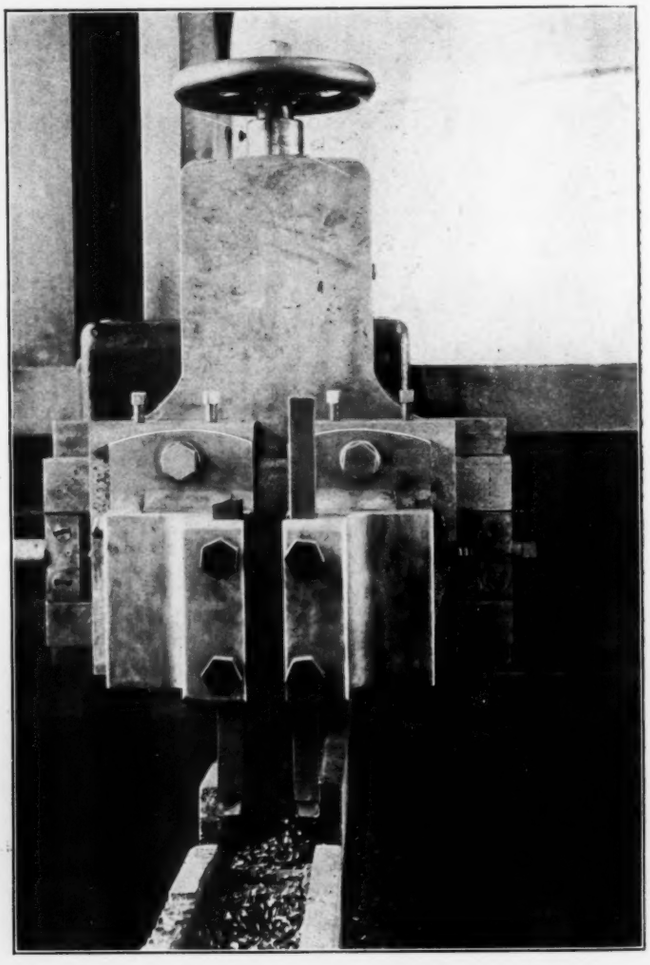
In another case a large number of antiquated air motors were collected and disposed of which were using 300 per cent more air than the standard tools. Other tools were gathered which were damaged and laid aside, but which at reasonable expense were placed in first class condition and reissued as new tools. Meanwhile a stock book has been prepared which shows all small tools on hand each month at each point and those which have been ordered. A continuous inventory is thus provided which makes it possible for the supervisor of tools to quickly and accurately check the requisitions and thus avoid overstocking.

Not the least important of the improvements has been the selection of standard designs for the different tools and the centralization of their manufacture at the main shops. As a typical example, the heavy bulky tools formerly used on the driving wheel lathes have been replaced with tool holders and high speed steel cutters, as shown in the illustrations. This has not only decreased the cost of these tools, for only the cutters are now of high speed steel where formerly the entire tool was of this material, but it has greatly increased their efficiency, because of the better design, and has made it possible to more easily maintain the tools in proper condition. As another illustration, one of the slotters was found to have 41 tools weighing more than 900 lb., 70 per cent of the tools being of high speed steel and representing in all an investment of over $500. These were replaced with two tool holders similar to those shown in one of the photos, and a full set of small tools of high speed steel. The total cost of these new tool holders and tools was less than 20 per cent of the cost of the old tools and they are more effective than the large clumsy ones.



Locomotive Parts Manufactured at Central Shop

In keeping a check on the small tools a record is maintained at each of the shop tool rooms showing just what tools each man has and requiring him to turn in any tools, which he may have taken from the tool room, every Saturday night for inspection and repairs. If any of the tools are found missing the man is notified on Monday morning that if he does not immediately turn them in he must get a release from the general foreman. If a tool is broken the workman must turn in a report which must be passed upon by his foreman. In this way weak or poorly designed tools are located and improved and careless handling is reduced to a minimum.

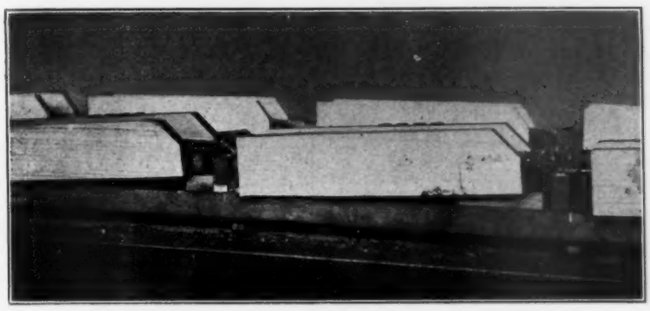


Double Planer Head for Machining Shoes and Wedges

It was found that there were a great variety of makes of tools of all kinds scattered over the system. As rapidly as possible it is proposed to reduce the number of different types; in the case of jacks, for instance, from 12 to four, and to standardize four sizes of air hammers and five sizes of air motors. Manufacturing the small tools on a large scale at a central shop reduces their cost very greatly since it is possible to furnish special facilities and specially trained mechanics. The tools shown ready for is-

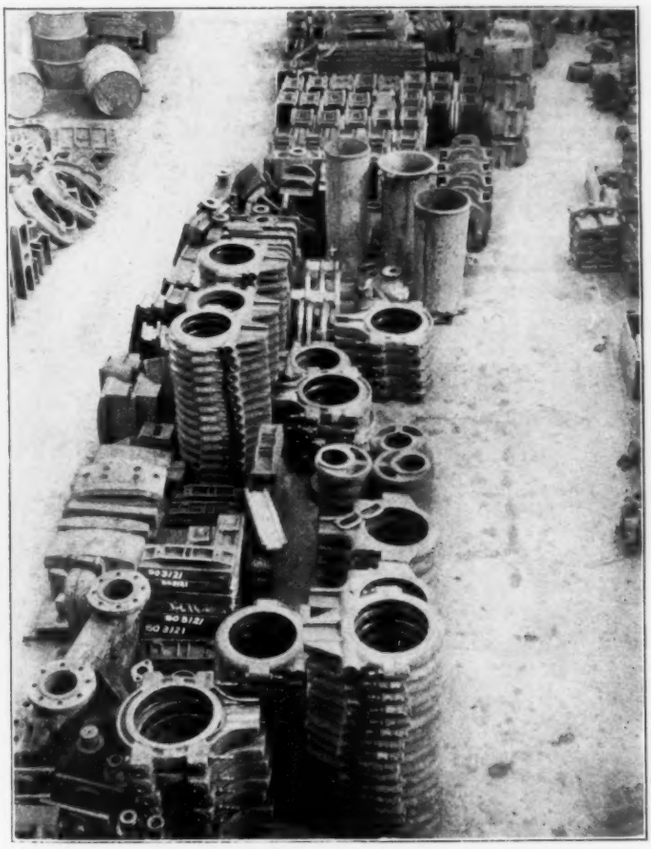
suance in one of the illustrations, for instance, are now made at a cost of less than one-half that under the old methods.

In brief, then, the principles which have been applied and which have resulted thus far in an increased efficiency of machine equipment with a decreased cost of maintenance are an intimate constant supervision of tool purchase, manufacture and distribution;



Special Device for Holding Shoes and Wedges on Planer

the establishment of standards of design for all small tools; the central manufacture of these tools in quantities to insure minimum cost and adherence to standards; the designing and installation of time and labor saving jigs to facilitate shop output; and the strengthening and rebuilding of machine tools to increase their capacity and their facility for turning out accurate work.



Finished Locomotive Parts on Storehouse Platform Ready for Shipment

CENTRALIZED MANUFACTURE OF MATERIAL

Considerable progress has been made in the standardization of certain locomotive parts and the manufacturing of this material on a large scale at the central shops. The practice of furnishing material in the rough to the small shops and engine houses is usually an expensive one because of inadequate tool equipment at such places. While the reduction in the cost of the finished material when manufactured in quantity at a central shop is an important advantage, it is not the greatest one. Where a supply of finished material is on hand ready for immediate application to the locomotives, the time in making repairs is very greatly decreased, whether these repairs are made at the larger shops or in the smaller shops and engine houses. Moreover, parts which are continually being worn out and broken in service may be replaced with little or no loss of time and the condition of the power is thus always maintained at a high point of efficiency. This means fewer engine failures, a reduction in running repair costs and an increase of mileage between shoppings. This is particularly important where the practice is to haul heavy tonnage trains, utilizing the full capacity of the locomotives, as has been done on the Frisco during the past year.

At present a considerable number of parts are either wholly or partially machined in large lots at Springfield and are shipped to the smaller points where the machine operations are reduced to a minimum. Many locomotive parts may be finished in quantity with special jigs and machinery at a small part of the cost which would be required at one of the smaller shops where the investment in special tools and machinery is not warranted. As an illustration, the centralized manufacture of shoes and wedges may be mentioned. When these are machined at a small shop or engine house in small quantities the labor cost runs from 40 to 75 cents apiece. With the special jig and double planer head arrangement at Springfield, shown in one of the illustrations, it is possible to machine these in lots of 40 at a cost of 10 cents each. The plan is to carry this development to a point that such parts as fireboxes, back ends and frames will be kept in stock, thus making it possible to return an engine requiring such repairs to service in a very much shorter time than would otherwise be necessary.

MILLING MACHINE EFFICIENCY

BY OWEN D. KINSEY
Tool Foreman, Illinois Central, Chicago, Ill.

With the installation of modern tool manufacturing machinery in the Burnside (Chicago) shops of the Illinois Central the productive capacity of milling machines appeared inadequate to handle the increased volume of work coming from the engine and turret lathes. Investigation disclosed many opportunities for improvements and a marked advance has been brought about by making radical changes in milling methods, in many instances speeds and feeds having been more than doubled. Numerous experiments have been made with the new style undercut, wide

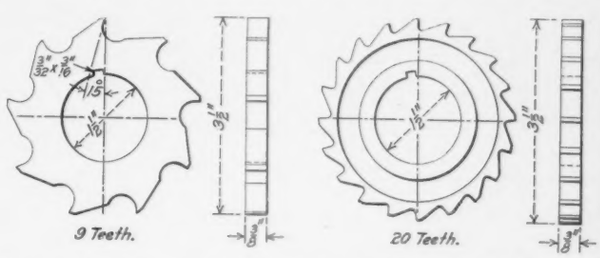


Fig. 1—Left, New Style Slotting Cutter; Right, Old Style Slotting Cutter

spaced cutters and advantage taken of the extensive experiments conducted in the works of the Cincinnati Milling Machine Company, to whom the writer is indebted for many valuable ideas and suggestions relating to modern milling machine practice.

A. J. Baker, of the Cincinnati Milling Machine Company, in a paper read before the Western Railway Club, made the following statement, the truth of which will be strikingly apparent to all who have had experience in handling metal-cutting tools: "A milling cutter is probably more unfortunate than any other tool, inasmuch as the user expects the one cutter to perform with equal

efficiency whether cutting cast iron, steel or brass." He states that in every case of which he knows the rake supplied on cutters is no rake at all, excepting in face mills; in other words, attempts

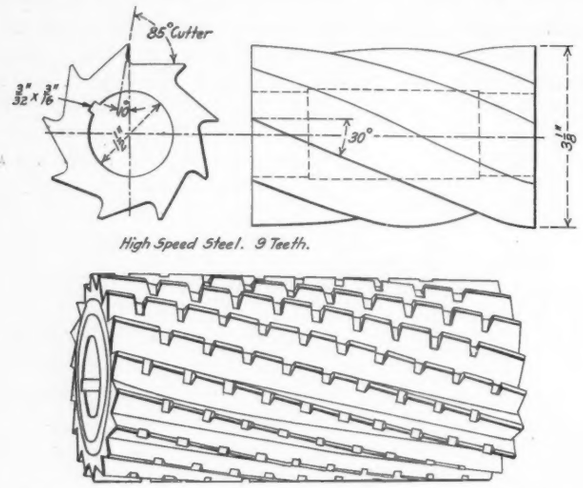


Fig. 2—New Style Milling Cutter Above; Old Style Below

are made to use on a milling machine a cutter that a lathe or planer hand would indignantly reject.

A lathe or planer tool probably exemplifies the most true cutting

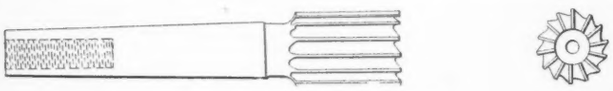


Fig. 3—Old Style End Mill

action of any metal cutting tool and it is a well known fact that a slight change in the angle of rake has a marked effect on its cutting efficiency and the power required to drive it. The thought

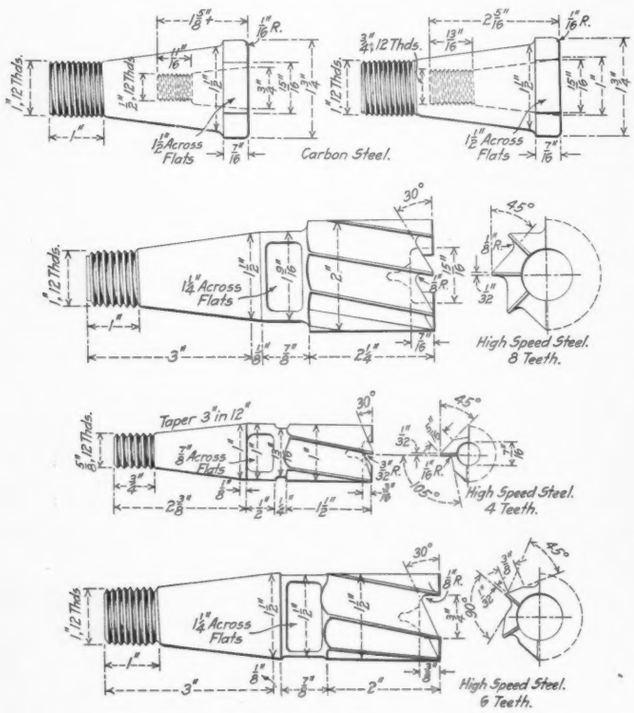
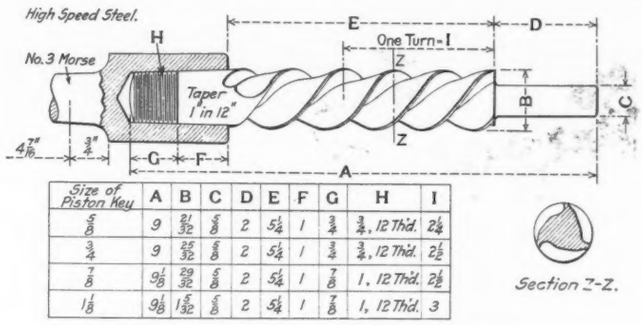


Fig. 4—New Style End Mills, and Bushings

to be kept in mind is that metal cutting is produced by the driving of a wedge-shaped tool between the work and the chip, separating it in a parallel line of cleavage; therefore there must be some provision made for the chip to escape if a free cutting action is to be obtained. A milling cutter is usually ground radial with the center and there is little or no opportunity for the chip to escape, consequently it pushes the chip through the work, generating heat and vibration, which are two of the most destructive



Size of Piston Key	A	B	C	D	E	F	G	H	I
5/8	9	21/32	5/8	2	5 1/4	1	3/4	3/4, 12 Thd.	2 1/4
3/4	9	25/32	5/8	2	5 1/4	1	3/4	3/4, 12 Thd.	2 1/2
7/8	9 1/8	29/32	5/8	2	5 1/4	1	7/8	1, 12 Thd.	2 1/2
1 1/8	9 1/8	1 5/32	5/8	2	5 1/4	1	7/8	1, 12 Thd.	3

Fig. 5—Helical Cutters for Piston Rod Keyways

causes which affect a cutting tool. The design of the milling cutter is of vital importance and a radical departure from standard cutters must obviously be considered if any marked advance is to be made in the art of efficient metal cutting. More depends on the design of a cutter and the manner in which it is presented

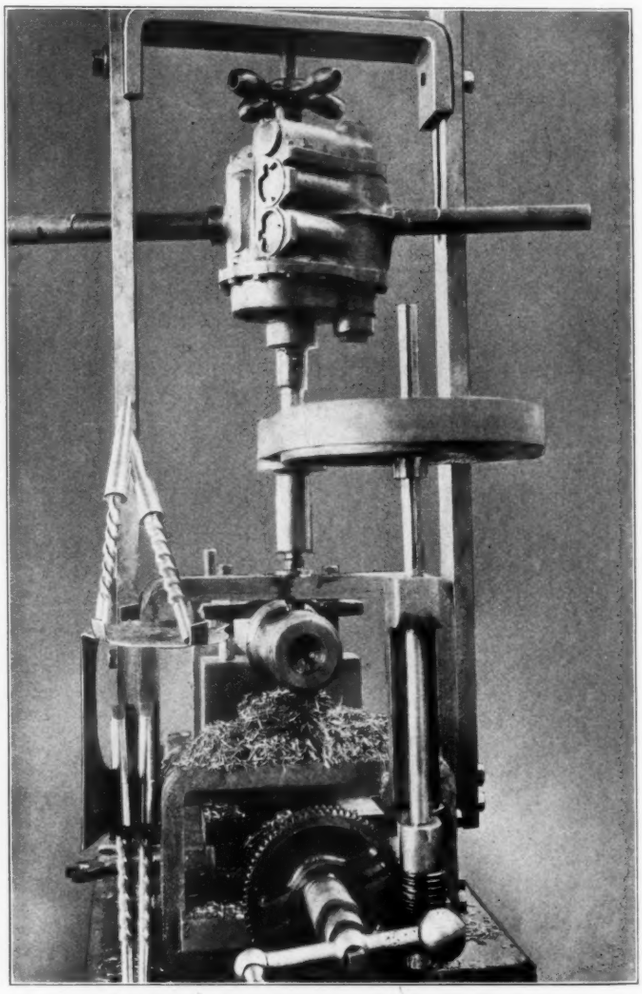


Fig. 6—Machine for Milling Piston Rods

to the work than the kind of steel used in its manufacture. This is shown in a surprising manner by experiments in which we have made comparisons.

Fig. 1 illustrates a modern and a standard slotting cutter with

which we made a comparative test. These cutters are of the same diameter and width and have a 1½ in. arbor hole. The material milled was machinery steel in which a cut ⅜ in. in width and 13/32 in. in depth was taken and the work was the milling of keyways in taper shank arbors, supported on centers. The standard cutter, working at 115 r. p. m., or 93 feet, and at a table travel of 2¾ in.

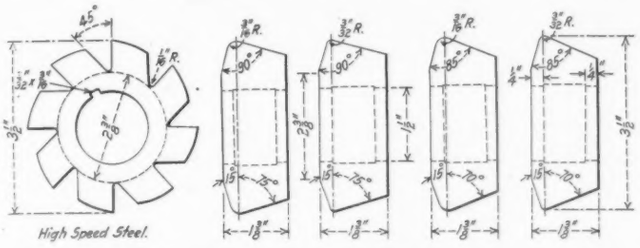


Fig. 7—Milling Machine Cutters for Washout Plug Taps, Etc.

per minute, could not be crowded further. The modern cutter was then started to work at the same speed and feed and was stepped up to 350 r. p. m., or 285 surface feet. The tumbler block controlling the feed was then advanced from 2¾ in. per minute up to 16 in. table travel per minute without the least sign of damaging effects to the cutter, or discoloration of the chips. We were unable to make further increases owing to difficulty in holding

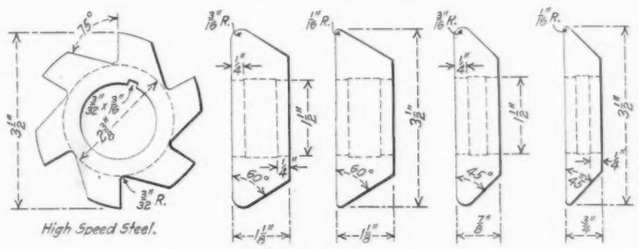


Fig. 8—Milling Machine Cutters

the work. This test was made without stream lubrication, which tends to show the possibilities of increasing milling machine productive capacity by correcting the design of the cutter.

Fig. 2 shows a comparison of old and new style milling cutters. The modern cutter has nine teeth while the standard cutter has eighteen. The modern cutter has teeth set at an angle of 30 deg. and ground with an undercut of 10 deg., the arbor hole being 1½ in. and the outside diameter of the cutter 3⅛ in. The stand-

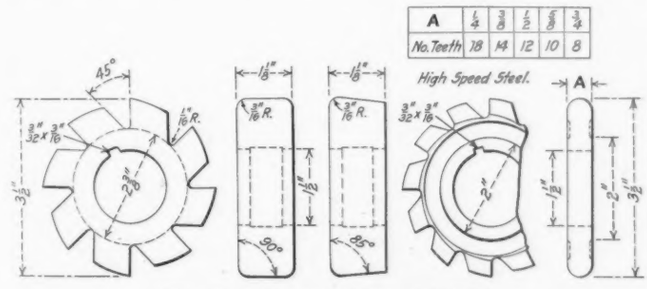


Fig. 9—Fillet and Convex Cutters

ard cutter has twice as many teeth and they are ground radial with the center. The angle of the spiral is 10 deg. and little or no fillet is provided at the root of the face. The diameter of the cutter is 3½ in. and the arbor hole is 1¼ in.

It is apparent that the spiral is better than a straight cutting blade, as it allows an escape for the chip and produces a shearing action. Referring to the illustrations, attention is directed to the sweeping curves representing the cutting edge of the modern cutter and the straight appearance of the standard cutter. Thus we can see why the modern cutter cuts freely and can be operated at so much greater speed, without generating heat. In the modern cutter there is no necessity for chip breakers; in fact they would be detrimental if used, although they may improve the standard cutter. The wide spacing of teeth gives more strength to the cutting edge and permits the chips to escape freely. Moreover with the wide spacing of teeth the power which drives the cutter

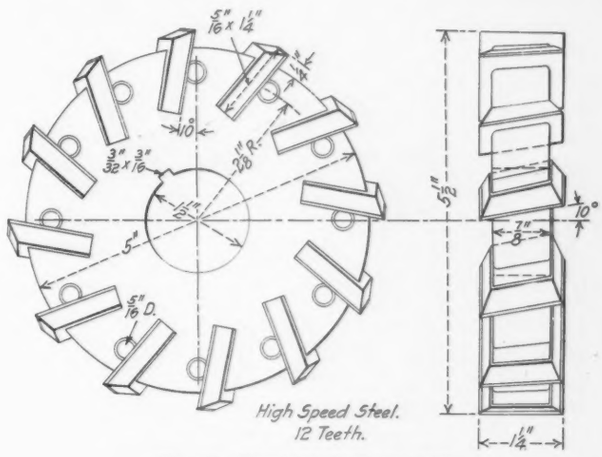
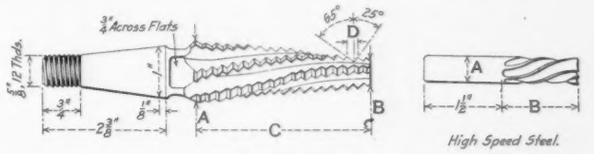


Fig. 10—Standard Straddle Mill

is concentrated behind fewer cutting edges, whereas in the case of the standard cutter this same power is distributed and increased effort is required of the machine.

Fig. 3 illustrates an old style end mill and Fig. 4 shows the style of end mills we are now using. These mills cut, instead of scrape, as is not the case with the old style cutters. Attention is



Size	A	B	C	D
No. 1	1⅛	7/16	3	5/32
No. 2	1⅛	9/16	3½	3/16

Size	A	B	No. Teeth	Pitch	Spiral
¼	⅜	1¼	6	6.12	L.H
⅜	⅜	1⅜	6	6.22	"
½	½	1½	6	6.48	"
⅝	⅝	1½	6	7.29	"

Fig. 11—Cutter for Alligator Wrenches; and Straight Shank Side Mills

called to the 3 in. in 12 in. taper shank, which we have made a standard for all our milling machines and attachments. This shank holds the cutter rigidly and owing to the short piece of steel required to make a cutter, shows economy in the use of high speed steel. The superiority of this style of end mill must be

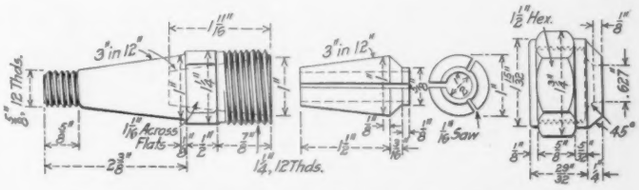


Fig. 12—Chuck for Straight Shank Mills

apparent to any one familiar with milling cutters. The old style end mill has many more teeth, consequently less strength and less chip clearance.

Fig. 5 illustrates a helical cutter used very successfully in milling the keyways of locomotive piston rods. We use four sizes of this style of cutter in the Burnside shops and mill our keyways in from 15 to 20 minutes. The action of the cutter is very inter-

esting as it cuts rapidly and throws the chips in a screwlike manner. The chips are spiral in shape and are quite long. The action of this helical cutter is a strong argument in favor of spiral cutting mills such as that shown in Fig. 2. The machine in which these cutters are used is shown in Fig. 6. It was designed by the general foreman at Burnside and will cut an average size keyway in 30 minutes, floor to floor.

Figs. 7, 8 and 9 show a group of grooving mills which we

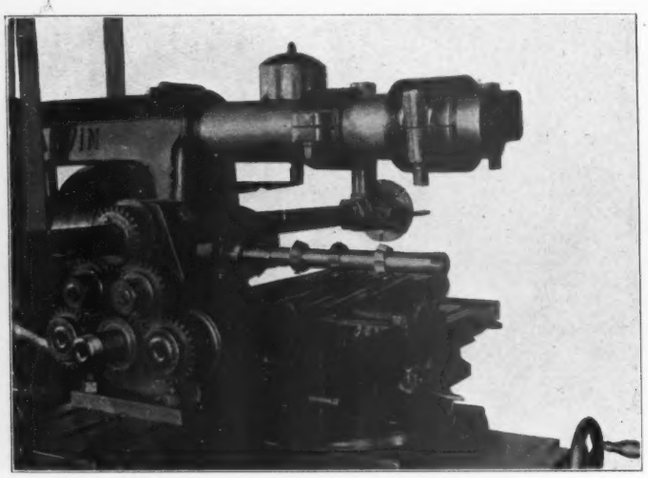


Fig. 13—Triple Head Milling Machine

have adopted as standard. They cover a wide range of railroad work and, as may be noted, have 1½-in. arbor holes, our standard arbor being 1½ in. in diameter.

Fig. 10 shows an improved straddle mill which is particularly efficient. We use this style of cutter in pairs for machining the tangs of drill sleeves, repair sleeves and numerous taper shank tools. We often run lots of 500 at a time and finish the tang complete in from one to one and a half minutes each, which is approximately ten times faster than the old method which was to

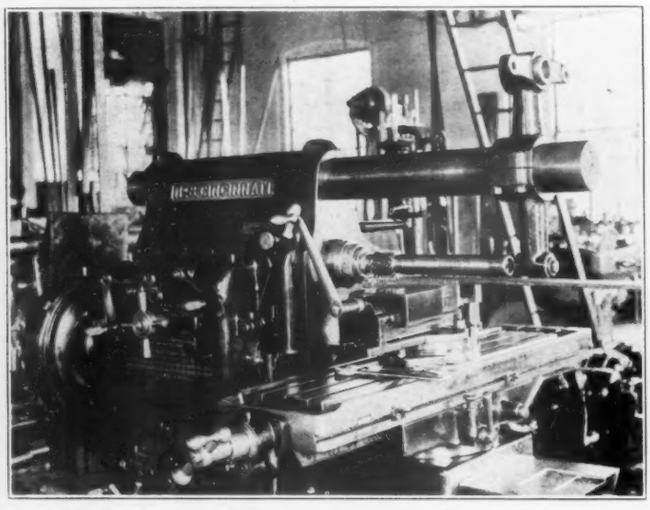


Fig. 14—High Speed Slitting Saws Making Rose Reamer Blades

place them on centers and mill one side at a time by revolving the dividing head. We straddle mill the squares on washout plug taps and reamers at greatly reduced costs. Our method is to rough turn the material in the turret machine and clamp in a V-block on the milling machine.

Fig. 11 illustrates a cutter used in making alligator wrenches and also a straight shank side mill. The chuck for holding this mill is shown in Fig. 12. It is made in the tool room and is used for a number of purposes. By its use considerable high speed steel is saved in manufacturing tools such as the straight shank side mill as the shank can be made very short; in this case only 1½ in.

Fig. 13 illustrates an original triple head milling device, which mills spirally three reamers at one operation, reducing the cost of reamer milling fully one-third. We regularly mill three spiral 16-in. rod reamers in from three to four hours, taking one cut for each flute. An apprentice operates this machine and we use this same device for sawing sectional tube expanders and other similar work. We average from 33 to 36 expanders in nine hours.

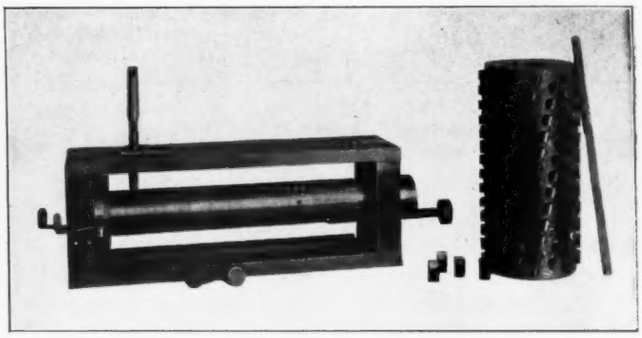


Fig. 15—Drilling Jig for Peg Slab Milling Cutters

Fig. 14 shows a gang of high speed slitting saws on a Cincinnati miller which accurately saws ten high speed blades 5/32 in. by ⅜ in. by 3 in. in one operation, producing 250 pieces in a day of nine hours. These blades are used in manufacturing inserted blade rose reamers, the bodies of which are machinery steel. The cost of cutting one set of eight blades is 3½ cents.

Fig. 15 shows a drilling jig in which we drill and ream bodies for inserted peg slab milling cutters. Cutters produced on this jig are undercut ten degrees and have all the characteristics of a modern milling cutter. We use this style of cutters on a rod milling machine on which it is a common practice to take a cut ⅜ in. in depth, 8 in. in width at 8-in. table travel per minute, the steel being of 75,000-lb. tensile strength. A dowell pin is placed in each peg to prevent it from turning under pressure from the

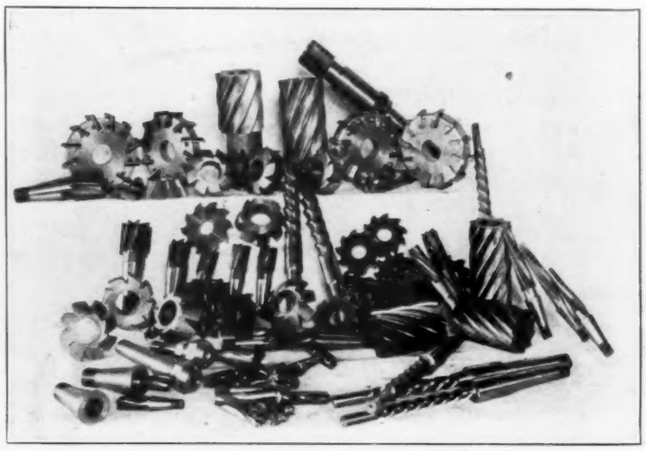


Fig. 16—Group of Tool Room Milling Cutters

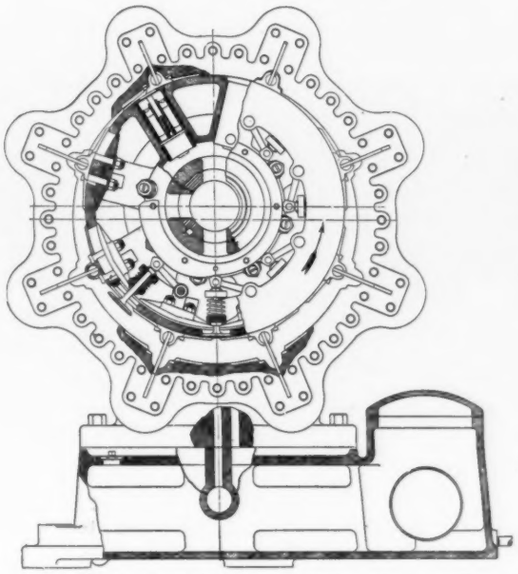
work. The teeth for these cutters are machined complete in accurate jigs and when driven in place the dowell pin serves to bring the cutting edges in perfect alignment. The cutter shown was manufactured complete by unskilled workmen and exemplifies what can be accomplished by introducing modern methods in railway shops.

Fig. 16 shows a group of milling cutters that were made and are used at the Burnside shops.

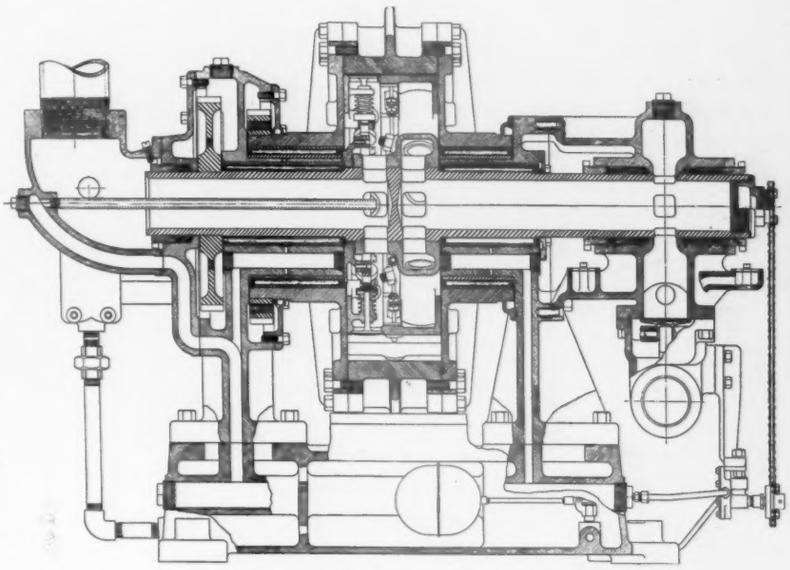
NEW DEVICES

ROTARY AIR COMPRESSOR

The Wernicke-Hatcher Pump Company, Grand Rapids, Mich., has recently placed on the market a rotary air compressor that is rather unique in principle and design. It consists essentially of a rotor and rotor case that revolve independently of each other at the same speed, but not on the same axis, together with the valves and driving mechanism. The machine is shown in the illustrations and its operation is well illustrated by the simplified drawings shown in one of them.



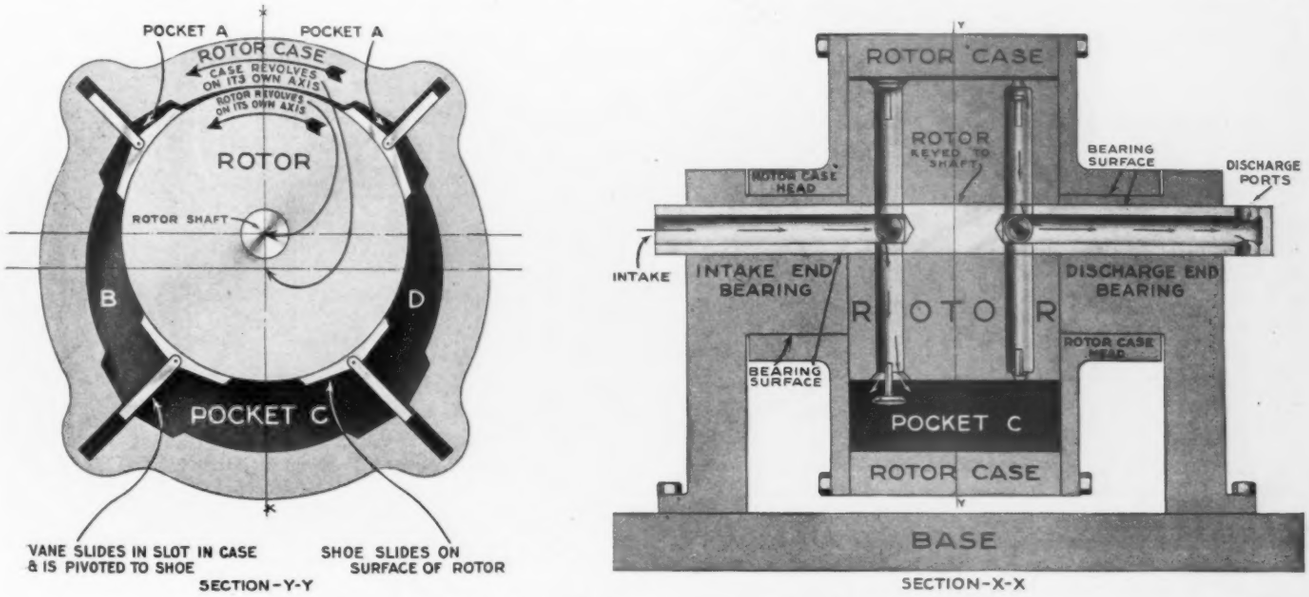
Cross Section Through Rotor Case of Type B Compressor



Longitudinal Section Through Rotary Air Compressor

The air is drawn in through one end of the rotor shaft and the intake valve by the partial vacuum caused by the increasing volumes of pockets *A* and *B*. In the position shown pocket *C* is at its maximum volume, and the intake valve is closed by a spring, which will be noted in the cross-section of the type B compressor illustrated on this page. As the pump continues to revolve the volume of pocket *C* will decrease, resulting in the compressing of the air which is forced out through the discharge valve in the rotor to a passage in the other end of the rotor shaft.

The vanes, which are provided to create the pockets, slide in slots in the rotor case, and the shoes in which they are held are free to slide on the surface of the rotor, the construction being shown in the cross section. These vanes are carefully fitted in the slots to eliminate the leakage of air from one pocket to another, and as the greatest pressure is always on the leading side of the vanes, it is only necessary to have the back of the

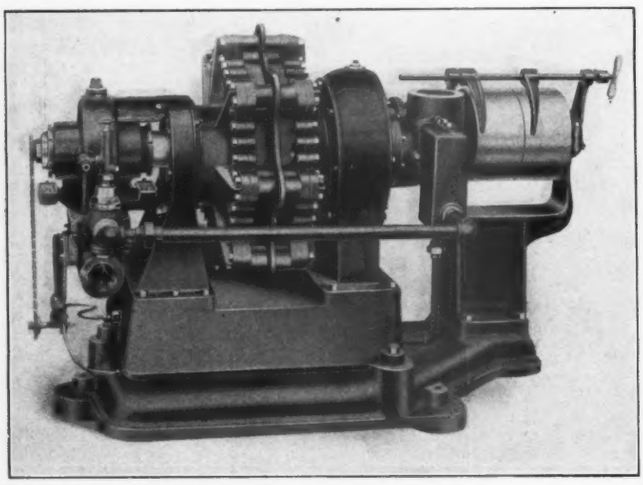


Simplified Drawing of the Rotary Air Compressor, Showing Its Operation

vane make a perfect seat with the corresponding surface of the slot. The intake valves are mechanically operated by means of a cam, as illustrated, and are opened for nearly one-half of the stroke. This permits of having a spring stiff enough to prevent leakage by this valve and to overcome the centrifugal force at all speeds within the rated maximum.

It is not necessary to provide any means of cooling, as the surface surrounding the compressed air is sufficient to radiate a large part of the heat generated by the compression of the air. In this regard tests have shown that with an intake temperature of 60 deg. Fahr., the temperature of the discharge when operating continuously against a pressure of 100 lb. is about 275 deg. Fahr. This radiation is also helped by the rapidly revolving rotor case. As may be expected, the rotating parts are carefully balanced in order to relieve the vibration that might be caused by revolving such heavy masses, and the makers claim that this is so carefully done that no foundation is necessary other than the bed of the machine. Roller bearings are provided at five different points on the shaft, and the friction caused by the other sliding parts is small, as they have a relatively small and slow motion. A forced feed lubricating system is used, the oil pump being driven from the end of the shaft by a chain and sprocket wheel.

The pump may be driven by a direct connected motor or by



Type B Single Stage, Power Driven, Rotary Air Compressor

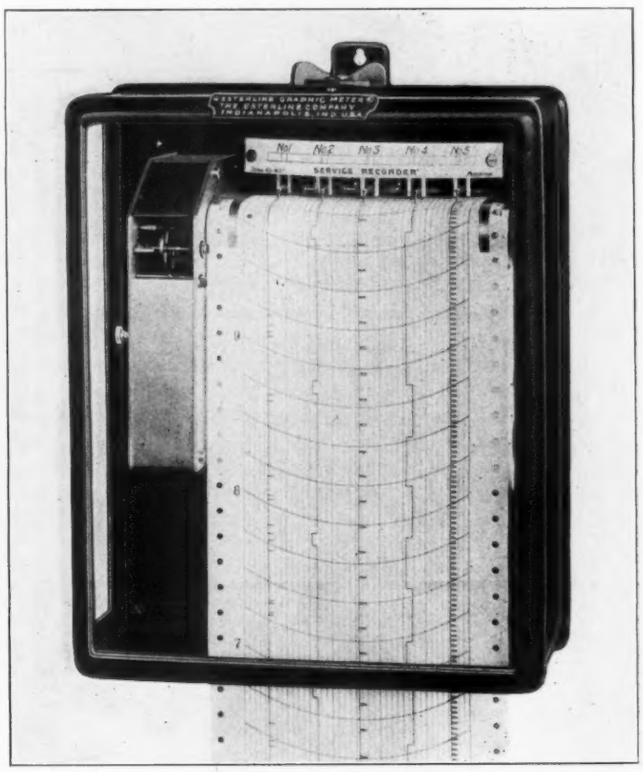
a belt, as shown above. The machine illustrated is type B, which has an approximate capacity of 75 cu. ft (actual delivery, not displacement) when operating against a gage pressure of 100 lb. and at a maximum speed of 400 r. p. m. A 20 h. p. motor when direct connected will drive this pump at this speed and pressure. This machine, it is claimed, is particularly serviceable where constant pressures are to be maintained, as it can be controlled automatically when driven by an electric motor. When greater capacity or higher pressures are desired, these pumps may be connected in parallel or series, as required.

ALLOY STEEL GEARS IN MACHINE TOOL CONSTRUCTION.—Considerable experimenting has been done by machine tool builders in an endeavor to follow automobile manufacturers in the use of alloy steel gears in gear-boxes and other power transmitting units of machine tools in order to prevent breakage and stripping of gear teeth. Alloy steel, such as chrome-vanadium and chrome-nickel has been used with more or less success. Where it is possible to make a complete analysis of the steel before working it up, it has been found that alloy steel gives far more trouble than ordinary carbon steel. The limits of fluctuation in heat-treatment are much narrower than in ordinary carbon steel, and the material must be handled much more carefully if good results are to be expected.—*Machinery.*

GRAPHIC SERVICE RECORDER

An instrument for recording machine tool operations has recently been placed on the market by the Esterline Company, Indianapolis, Ind. It operates on the same general principles usually employed in graphic or curve drawing instruments, and is equipped with any number of electrically controlled pens desired, from one to ten, inclusive. The entire instrument is mounted in an enameled metal case, with rubber-covered binding posts located at the bottom for making connections and suitable lugs at the top and sides for fastening to a wall or partition. The front cover enclosing the chart and clock is provided with glass panels on the sides, top and front to permit inspection of the record without opening the instrument.

The pens rest on a long strip of paper or record chart which is driven through the meter at a constant rate of speed by a high-grade jewel balance wheel type eight day clock. The clock may be equipped with gears giving five paper speeds of ¾ in., 1½ in., 3 in., 6 in. or 12 in. per hour. An attachment can also be provided, giving additional chart speeds of 45 in., 90 in., 180



Esterline Graphic Recorder

in., 360 in. and 720 in. per hour. The clock is provided with a regulator for adjusting the speed in service, and with stops so that its operation may be interrupted at any time. A re-rolling device is furnished for winding up the finished record in the bottom of the case. This may be omitted if desired, and the finished chart fed through a slot in the bottom of the cover, the record being torn off daily. Record charts are supplied in rolls 90 ft. in length and six in. in width, which may be torn into short lengths for convenience in filing. Peforations are provided along each margin of the chart, which are engaged by pins on the driving roll to insure perfect alinement and accurate timing of the paper.

Each pen is so controlled that when a record is made a vertical line about one-eighth inch in length is drawn across the chart, the pen returning to the zero position after each record is made. The controlling devices for the various pens are connected to different machines in such a way that one record is produced for each operation or for a certain number of operations. The

resulting record is a series of short lines, the spacing of which represent the rate at which operations are being completed. If the machine is being operated up to capacity, the series of lines will be close together, but if the machine stands idle for several minutes, a straight horizontal line will be drawn across the chart showing that no work was accomplished during this time. The electrical control for the pens is very efficient and requires such a small amount of current that the power consumption is negligible. The instruments have high internal resistance and may be operated at any distance from the machines. One instrument may be located in the office of the foreman or superintendent, and operated by small wires connected to the machines located at various parts of the plant several thousand feet away. Any source of direct current, either storage battery or shop voltage, may be used for operating the instrument.

On machines operating at a high rate of speed and completing a number of pieces or operations in a short period of time, it is advisable to gear the controlling device on the machine so that one line on the chart will represent 10, 100 or any other convenient number of operations. On account of the large possible number of chart speeds that may be obtained on this instrument, it is easily possible to get a suitable record on any class of work. The instrument is furnished with a counting attachment arranged in such a way that it totals the operations, the total production for the day or period being quickly determined direct from the recorder.

Service recorders are used for a variety of purposes, in addition to machine tool recording. The pens may be arranged to show when motors or other machines are being operated and when idle. They are also used for traffic recording on interurban and street railways, the record showing the time at which cars pass given points on the system.

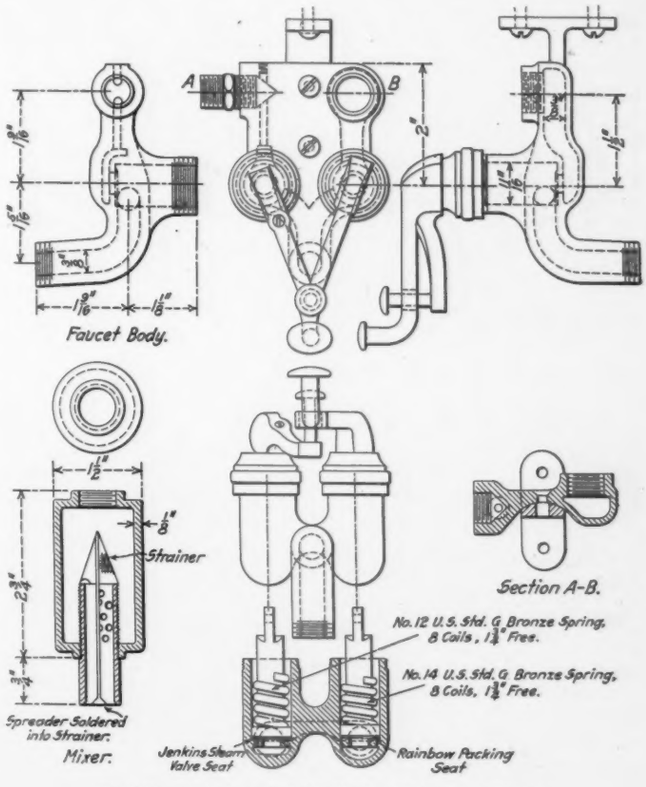
CHADWICK MAIL CAR FAUCET

BY R. S. LOWDER

A hot and cold water faucet developed and patented by J. N. Chadwick has been installed in a number of mail cars recently built by the Pullman Company. This faucet, which is installed with a folding wash basin, is designed to heat and deliver water to the basin at any desired temperature, and is especially adapted for service on mail and baggage cars, which are not equipped with a regular water heating system.

Hot and Cold Water Faucet in Position in a Folding Wash Basin

The faucet body is provided with two valves, one of which controls the cold water inlet and the other a steam inlet. The valves are of the ordinary telegraph type, seated against the pressure by means of coiled springs, the passages from both



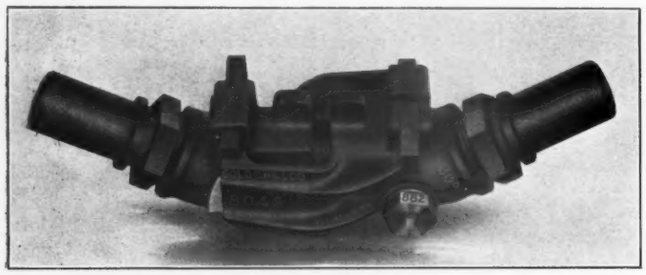
Details of Hot and Cold Water Mail Car Faucet

valves leading to a single outlet. The main handle operates the cold water valve and is so arranged that water is admitted before the secondary handle which controls the steam is engaged. The arrangement of the handles for this purpose is shown in the engraving. The point at which steam is admitted to the faucet can be adjusted by a set screw in the steam valve handle. The heel of this handle is rounded so that the valve is operated on depressing the handle but not on raising it. If a full stream of cold water is desired the main handle is raised to its full height and no steam is admitted. If desired the steam valve may also be operated independently. Attached to the faucet is a mixing chamber, a sectional view of which is shown in the engraving. A small spreader designed to prevent splashing is included in this chamber. The steam and water are here thoroughly mixed and the water is delivered to the basin at a uniform temperature. The faucet is held in place against the wall by means of a bracket, the holes in which are slotted for adjustment.

AEROPLANES IN FRANCE.—As the result of voluntary contributions by citizens in the great National Aeroplane Subscription which was inaugurated two years ago, 208 aeroplanes have been presented to the French army. Since the beginning of 1911 nearly 1,000 aeroplanes have been acquired by the French army. The Bleriot Works, alone, has built 181 military aeroplanes and the Farman Works, 105. This indicates why the aeroplane industry in France has developed to such an extent as compared with that in other countries.—*Machinery.*

POSITIVE LOCKING STEAM HOSE COUPLER

A steam hose coupler having a positive locking device and a gravity trap has recently been introduced by the Gold Car Heating & Lighting Company, New York City. As shown in the illustration these couplers operate in the ordinary way and are interchangeable with other makes. When coupled the joints may be locked by driving the wedge of one coupler over the toe of the other. The wedges are drop forgings held in place by springs, and the ends are upset to secure them to the couplers.

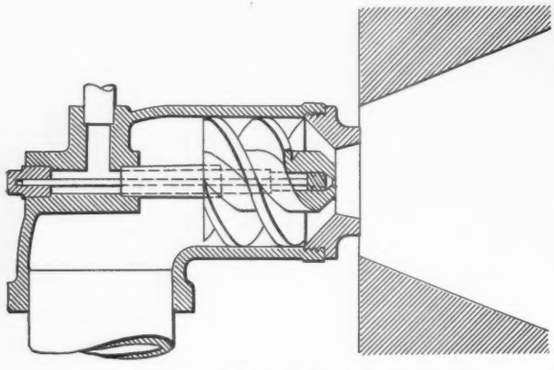


Steam Hose Coupler with Positive Lock and Safety Trap

Vulcabeston gaskets of the oscillating type developed by this company have been used, and the couplers are equipped with gravity traps. The trap valves are designed to remain seated while under pressure and to open by gravity when the pressure is released, thus draining the hose connections of all condensation, and serving as a protection against scalding when disconnecting the couplings.

FUEL OIL BURNER

A fuel oil burner so arranged that the oil is atomized and mixed with air outside of the burner has been developed by H. B. Stilz, 1938 North Marvine street, Philadelphia, Pa. The arrangement of the parts of the burner is shown in the sectional drawing. Oil under 50 lb. pressure enters an inner nozzle through the small pipe shown at the top of the burner. Near the orifice is a spiral which gives the oil a rapidly whirling motion, thus causing it to spread out in a cone-shaped film as it leaves the burner. Surrounding the inner

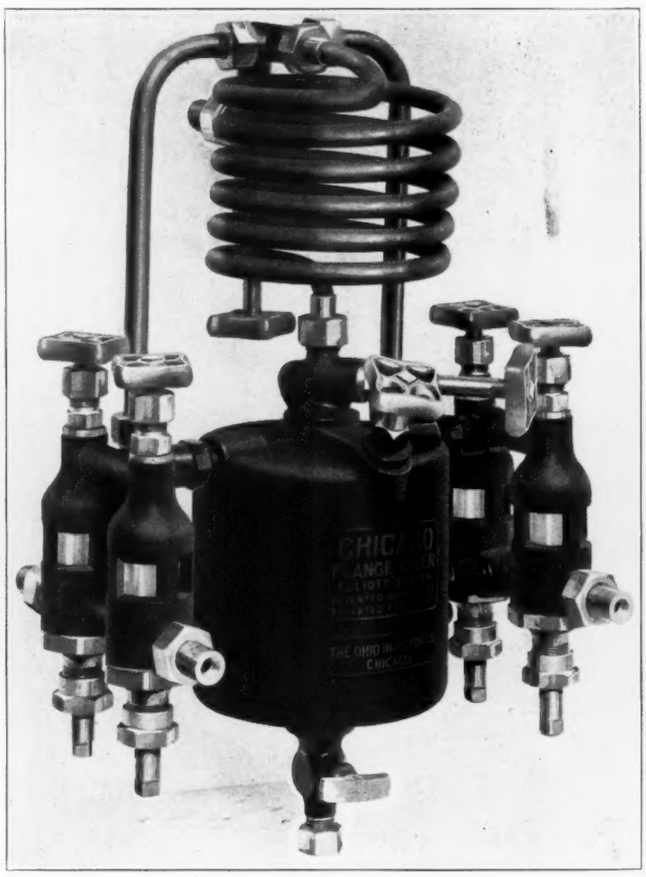


Fuel Oil Burner with Outside Atomization

nozzle is a casing enclosing a large spiral through which air or steam is forced under about 8 oz. pressure, being thus delivered from the discharge orifice in a whirling cone with a backward suction at its center. This suction draws the oil film into the whirling current of air where an intimate mixture is effected. By varying the shape of the outer orifice any shape of fire desired can be produced so that for any type of furnace the admission hole through the furnace wall can be completely filled with flame. As the high velocities at the nozzle are rotative, the atomized oil does not advance faster than the rate at which air is drawn into the furnace by the chimney draft. This is claimed to insure ample time for the mixture of sufficient air from the induced draft to effect complete combustion of the fuel within a small space in front of the burner and the admission of an appreciable excess of air into the furnace is unnecessary. These burners are built in sizes capable of handling from less than one gallon of oil per hour to 400 gal. per hour. They are claimed to be suitable for every variety of fuel oil and with proper provision for preheating the fuel have been successfully used to burn tar.

FOUR-FEED FLANGE OILER

The Chicago Injector Company, Chicago, has placed on the market a four-feed flange oiler for use on switch and Mallet locomotives, or any other type which requires flange oiling on four drivers. This system, also known as the Elliott system, works on the principle of an ordinary lubricator, the oil being placed in the oil bowl and forced through the sight feeds by steam pressure to nozzles located two inches away from the flange of the driver to be lubricated, and about half an inch in front of the tires. A steam connection is made to the lower



Chicago Flange Oiler with Four Feeds

side of the drip, which sprays the oil on the flange. An asphaltum oil that contains no grease should be used; a greasy oil will tend to spread over the top of the rail and the tread of the driver, causing the locomotive to slip.

For Mallet engines the nozzles should be applied to the back of the front driving wheels on both high and low pressure units. When this type of engine is used in switching service two of the four feed oilers should be used and the nozzles applied to the back of the front drivers and to the front of the back drivers of

both the low and high pressure engine units. For switching engines the nozzles should be applied to the back of the front driver and to the front of the back driver on both sides of the engine. Care should be taken to see that the nozzles are maintained in their proper location, so that the oil will be properly sprayed on the flange and not on the tread of the wheel. The oiler is provided with valves and passages whereby it may be thoroughly cleaned with live steam from the boiler, and in order to obtain the best service it should be maintained in a clean condition at all times.

SAFETY FIRE QUENCHER FOR BLACKSMITH SHOPS

A device for quenching forge fires in the blacksmith shop, designed to eliminate the danger of scalding arising from the sudden application of a large quantity of water to a hot fire, has been developed by A. W. McCaslin, master blacksmith of the McKees Rocks shop of the Pittsburgh & Lake Erie. Mr. McCaslin is the inventor of an improved type of blacksmith forge which is now used by a number of railroads and in the illustration the safety quenching device is shown applied to one of these forges.

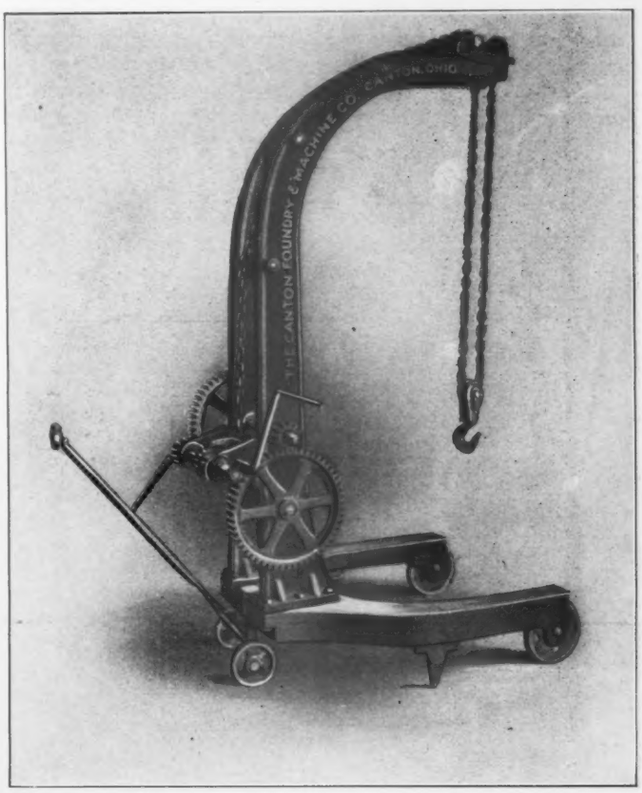
Water is supplied to each double forge from a pan located

Safety Device for Quenching Forge Fires

between the backs of the two fires by pipes extending through the back walls. Each pipe terminates in a nipple over which a 2 ft length of 1¼. in. perforated pipe may be slipped when it is desired to quench the fire. By opening a valve at the side of the forge a spray of water is delivered from the pan which gradually quenches the fire without the formation of more steam than can be accommodated by the uptake. When not in use the perforated pipe is removed. This device not only eliminates all danger to the men of being scalded by throwing large volumes of water upon the fire, but gives the slack coal a better chance to cake and leaves the fuel in much better condition for future service. The water pan is fed from the water line running through the shop, the only attention required being to turn off the water when the pan is filled.

PORTABLE CRANE WITH BACK GEAR

A portable floor crane and hoist which has found considerable application in railroad shops was described in the October, 1913, issue of the *Railway Age Gazette, Mechanical Edition*, page 568. This crane is manufactured by the Canton Foundry & Machine Company, and is designed for handling work not exceeding 3,000 lb. in weight. Where weights greater than this are



Portable Crane and Hoist Equipped with Back Gear

required to be lifted it is usually impossible for one man to do the work alone. In order to provide for work heavier than 3,000 lb. and ranging as high as 5,000 to 6,000 lb. the crane has been redesigned to include a back gear, thus enabling it to be handled by one man without assistance. The back gear crane has a total height of 8 ft. 9 in., and will lift up to 7 ft. 6 in. It weighs 1,400 lb., and has a capacity of 6,500 lb.

MOTOR DRIVEN SLOTTING MACHINE

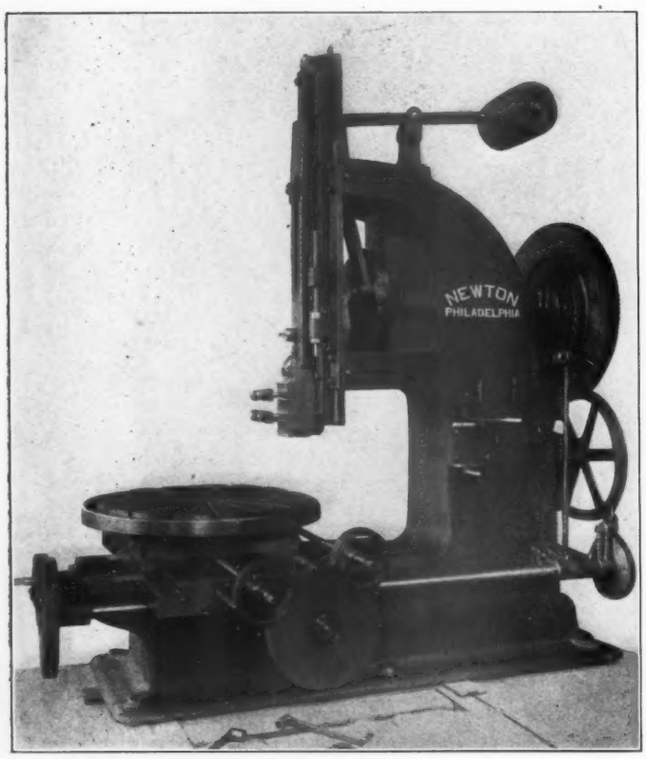
The slotting machine shown in the illustration has been developed recently by the Newton Machine Tool Works, Inc., Philadelphia, Pa. It is particularly adapted to slotting open end rods, finishing brasses and other similar work and is equipped with a type of gear box transmission especially suited to the use of alternating current motors.

A noteworthy feature of the design is the location of the speed change gear box within the upright of the machine whence it may be removed to facilitate repairs or replacements. The different speed combinations, six in number, are controlled through the latch levers shown on the side of the upright, which operate

sliding sleeves on which the several groups of gears are mounted. The arrangement is such that the lower train of gears revolves continuously in an oil bath, thus insuring efficient lubrication.

The machine is driven by a 10 hp. motor which is attached to one side of the upright, motion being transmitted through spur gears to the large plate gear shown at the back of the machine and thence to the cutter bar through a crank disc arranged to give a quick return stroke. All dangerously exposed gears are covered with meshed guards which are not shown in the illustration.

The cutter bar, which is of heavy box construction, carries a tool apron designed to relieve the tool or to be fixed as desired, and which has vertical and horizontal steel faced clamping surfaces. The bar has square lock bearings in the guide and a continuous taper shoe for side adjustment. The vertical adjusting screw is relieved of strain when cutting by means of a serrated clamping surface on the front face of the bar. The adjusting screw is operated by means of a square shaft projecting from the face of the bar. The cutter bar guide has square lock bearings



Slotting Machine With Inside Speed Box

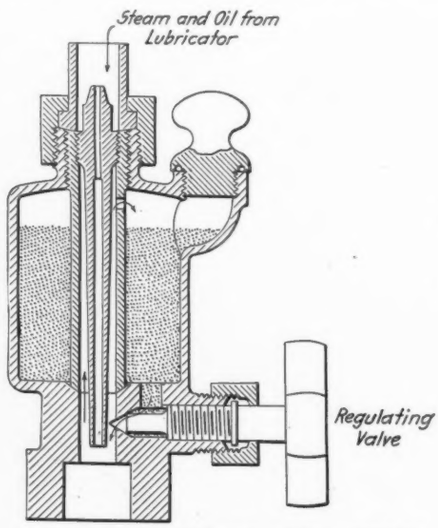
in the frame and is adjusted vertically to suit the location of the bar by means of a hand screw shown in the illustration. The cutter bar yoke has a bearing on each side of the connecting rod thus supporting the pin in double shear, and the stroke adjusting screw is relieved of strain by tongues on the connecting rod washer which engage grooves in the face of the crank pin.

The work table is surrounded by an oil pan forming an integral part of the casting, the periphery of which is graduated in degrees. The horizontal adjustment of the saddle on the cross slide and of the cross slide on the base are made by means of taper shoes. Power feed connections are provided for all motions of the table, including the circular motion of the table itself, as well as the in-and-out and cross movement of the saddle and cross slide respectively. For ordinary requirements the machine is designed to give a range of cutting strokes varying from 8 to 40 strokes per minute, but where desired the limits of the range may be altered, the ratio, however, remaining the same.

GRAPHITE LUBRICATOR

The Graphite Lubricator Company, Detroit, Mich., has placed on the market a graphite lubricator for lubricating with flake graphite the valves and cylinders of locomotives. This graphite is suspended in common engine oil for the purpose of more easily filling the lubricator. The device is used in connection with the oil lubricator as now in use on locomotives. The present oil lubricator acts as the cleaner, while the graphite lubricator delivers graphite to the cylinders and valves as the lubricant. The accompanying illustration clearly shows its construction. The oil line from the steam or gravity-feed lubricator in the cab is connected to the top of the graphite lubricator, and the oil and steam pass to the cylinder and valves through the nozzle shown on the inside. The graphite is contained in the annular space surrounding this nozzle, and the feed is controlled by means of the regulating valve, as shown. The pulsating pressure of the steam will cause the feeding of the graphite through the passage controlled by the regulating valve, and there it becomes mixed with the oil from the gravity-feed lubricator. It is then distributed to the various parts of the valves and cylinders.

This lubricator is adapted for use on superheater and compound locomotives (either piston or slide valve type) and especially those engines which experience trouble in obtaining the



Cylinder Lubricator for Flake Graphite

proper lubrication of the valves and cylinders. It is claimed that the priming of locomotives will not in any way interfere with the proper lubrication of the cylinders and valves where this lubricator is used. It is also claimed that 50 per cent less cylinder oil will be required for lubrication in the cylinders and valves, and that at the same time a better lubrication will be obtained by the use of the flake graphite.

The lubricator shown, which will hold three ounces of the graphite lubricating mixture, is filled through the plug shown at the top and to the right of the lubricator. It may be attached to any standard steam chest choke-plug fitting, and thus eliminates the use of the choke plugs. One filling of the model A three-ounce lubricator is sufficient for the operation of a locomotive for approximately 250 miles without further attention on the part of the crew. At present the lubricators are made in two sizes—model A, which holds three ounces of lubricant, and model B, which holds six ounces.

German Canal Locks.—The locks of the Kaiser Wilhelm Canal in Germany, which is playing an important part in the naval strategy of the present war, are the largest in the world, being 72 ft. longer and 38 ft. wider than the locks of the Panama Canal.—*Machinery.*

NEWS DEPARTMENT

The Boylston street subway, in Boston, which has been under construction for the past two years, was opened for traffic October 3. This subway is about 1½ miles long, extending from the north-and-south subway near the Public Garden westward toward Brookline.

The Delaware, Lackawanna & Western has finished, at Hoboken, N. J., as a part of its wireless telegraph equipment, a steel tower, 402 ft. high. The Hoboken office now has a five-kilowatt Marconi apparatus, and messages have been sent from Hoboken to Buffalo, 410 miles. The wave length is 2,250 meters.

The Interstate Commerce Commission has postponed to March 31, 1915, the date on which carriers must have complied with its order under the transportation-of-explosives act, requiring gas cylinders to be supplied with certain safety devices. Owners of such cylinders placed orders in Europe for the required devices, but now have informed the commission that their orders cannot be filled within the time limit fixed.

A recent statement issued by the New York Public Service Commission, First district, reports that the total number of tickets sold for passage in the Broadway and Lenox avenue subways operated by the Interborough Rapid Transit Company during the year ended June 30, 1914, was 340,413,103, an increase for the year of 12,941,593. As the commission treats Sundays as half days, the daily average for the first time in the history of the subway exceeds 1,000,000 passengers, the average having been 1,001,215. The daily average for the previous year was 963,152.

At a recent meeting of the Illinois legislative committee of the Brotherhood of Locomotive Firemen and Enginemen at Springfield, it was decided to advocate a change in the federal hours of service law, to reduce the maximum hours of trainmen from 16 to 10 hours a day. Other legislation is to be advocated which would provide for a limitation on the number of cars in a train, a uniform code of signals, giving trainmen a right to vote when they are away from home on election day, standardization of overhead and side clearances, and giving the Interstate Commerce Commission power to specify the type of steel cars to be used in passenger trains.

The management of the Pennsylvania Railroad has begun a campaign to keep passengers from standing on the platforms of moving passenger cars. Letters have been sent to the various industries around Pittsburgh, requesting them to post notices in their factories warning their employees (hundreds of whom ride on Pennsylvania trains daily, going to and from their work) of the danger of standing on the platforms of moving cars; and a general notice to passenger trainmen has been posted on the bulletin boards calling for a concerted effort on the part of trainmen to keep passengers from riding on platforms or steps of cars between or approaching stations.

Representative Rupley, of Pennsylvania, has introduced in Congress a bill to amend the interstate commerce law, providing that after the physical valuation of the railroads has been completed by the Interstate Commerce Commission the government may buy such lines at the price set as the actual value of the roads, as may in the opinion of the commission be desirable, and that if at the expiration of 90 days from the offer to the railways the companies decline to sell, the government may enter the open market to buy such securities as may be necessary to obtain control. The price to be paid, however, must not exceed that set by the physical valuation. An initial appropriation of $250,000,000 would be provided by a bond issue.

EVENING ENGINEERING COURSES AT UNIVERSITY OF PITTSBURGH

An evening school of graduate courses in engineering will be a new feature introduced at the University of Pittsburgh this fall by the Dean, F. L. Bishop. It is stated that in the Pittsburgh district there are more engineering graduates than in any other district of equal size in the United States, and the University will provide for men who do engineering work during the day an opportunity to study engineering in the evening. Courses will be offered in the valuation of public utilities, civil, electrical, sanitary, mechanical, railway and concrete engineering. The faculty will include Paul M. Lincoln, professor of electrical engineering; Louis E. Endsley, professor of railway engineering; R. T. Stewart, head of the department of mechanical engineering; J. Hammond Smith, head of the department of civil engineering, and Morris Knowles, director of the department of sanitary engineering, all of the University of Pittsburgh. Professor G. W. Case and William S. Moorehead will also assist in the course in the valuation of public utilities, and D. F. Crawford, general superintendent of motive power of the Pennsylvania Lines West of Pittsburgh, will co-operate with Professor Endsley in the work of mechanical railway engineering.

TWELVE-TON PACIFIC TYPE LOCOMOTIVES

The Panama-Pacific International Exposition at San Francisco next year is to have on the grounds a steam passenger railroad. Electricity is not absolutely supreme and all-pervasive. However, the track is to be of 19-in. gage and the locomotives are only 17 ft. long. As in the case of the Centennial Exposition at Philadelphia in 1876, the little railroad is designed not only to ride over but also to be looked at. There will be 2½ miles of road and 5 miles of track, work on which has just been begun. There will be eight or ten Pacific type locomotives equipped with air brakes, standard couplers and electric headlights. Each little giant will haul a train of ten miniature passenger coaches, and running on regular schedules on a double-track system. Each of the coaches, with a width of 42 in. and a length of 20 ft., will contain ten transverse seats, and will seat twenty passengers. With ten coaches to each train and eight trains in operation, 1,600 people can be put in motion at once.

The route, commencing at the terminal at the southeast corner of the Palace of Machinery, will be northerly across the plaza of the exposition ferry slips, to the water front, thence west along the Marina, around three sides of the Yacht Harbor, diagonally across the gardens of the California building, and thence by way of the bayshore and the many state buildings to the race track. The main loading station, at the beginning of the line at the Machinery Palace, will be 300 ft. in length, with five tracks; between which will be elevated loading platforms. The entire line will be double tracked, with rails weighing 39 lb. per yard.

A SAFETY-FIRST MOTION-PICTURE PLAY

Marcus A. Dow, general safety agent of the New York Central Lines, has recently had produced a rather remarkable motion-picture play entitled "Steve Hill's Awakening" for use in connection with the safety-first work now being conducted by the New York Central. The picture, a brief description of which is given below, is one of the first produced under railroad auspices for this purpose, telling a story of human interest with its principal parts played by professional actors. The scheme was carried out with the idea of departing from stereotyped methods, Mr. Dow, who some time ago introduced the safety exhibit car on the New York Central Lines (Railway Age Gazette, August 8,

1913, p. 228), having seen the necessity of introducing a feature that would create sufficient interest among the employees to bring them into the safety meetings willingly. And, of course, a "human interest" story will leave on their minds a more lasting impression than the ordinary didactic lecture. It is the intention of the company to show the "movie" in a specially equipped car, to be run over all of the Central lines, as has been done with the safety exhibit cars, stopping at the principal points. The pictures will also be used at large safety meetings conducted in halls or theaters in the various cities on the line.

The story is in brief as follows:

Henry Hill, a trainman, at the end of his run, coming in to the yard and jumping off the caboose, starts, against the advice of a fellow employee, to take a short cut along the tracks to his home, and is struck by an engine and killed, leaving a widow and two children, a boy and a girl. Soon after this the family is dispossessed, the widow later dies in poverty and the two children are sent to an orphan asylum. Fifteen years later, the son, Steve Hill, becomes a brakeman in the yard where his father was killed. He is of careless habits and is shown on the screen taking the usual risks, such as kicking a drawbar with his foot and jumping on the front of a moving yard engine. For this conduct he is reproved by the yardmaster, Jack Warren. The "human interest" of the story comes in when "Steve" meets Mary, the yardmaster's daughter, and courts her. The father's consent to marriage is withheld because of Steve's careless habits in his work. Steve, nevertheless, does not take the lesson to heart, and a short time after, disregarding a blue flag, he causes a slight collision on a repair track, and knocks a car body off its supporting horses, thereby causing serious injury to a car repairer. He is then discharged, at once; and is also repudiated by Mary. Going home in a disconsolate mood, he throws himself on his bed, falls asleep and has a dream, in which he sees himself taking all sorts of chances. For instance, he crosses the track between two cars and barely escapes being crushed. He is hurled from a side ladder by a car which stands out beyond the fouling point. Walking across a track without looking where he is going, he is almost run over by an engine. Finally, however, he takes one chance too many and loses his leg. He awakes from his dream with a start, overjoyed, to be sure, to find that his leg is not gone; but taught a lesson that makes him begin anew with "Safety First" as his motto. He is reinstated in his job, and marries the girl. The scene then passes to thirty years later showing him and his wife, both gray haired, in their happy home. "Steve" is telling a party of friends that his policy of Safety-First has made him a successful railroad man.

The picture is in two reels, and takes about half an hour to show. It is well done, and is to be classed as better than the average. Mr. Dow says that the Atchison, Topeka & Santa Fe; the Chicago, Burlington & Quincy, and the Delaware, Lackawanna & Western have made arrangements to use the film.

MEETINGS AND CONVENTIONS

Car Foremen's Association of Chicago.—The Car Foremen's Association of Chicago held its annual meeting in Chicago, October 13, 1914, at which time the following officers were elected: President, C. J. Wymer, general car foreman, Belt Railway, Chicago; first vice-president, A. LaMar, master mechanic, Pennsylvania Railroad, Chicago; second vice-president, A. L. Beardsley, master mechanic, Atchison, Topeka & Santa Fe, Chicago; treasurer, M. F. Covert, assistant master car builder, Swift & Company, Chicago; secretary, Aaron Kline, 841 North Lawler avenue, Chicago.

American Society of Mechanical Engineers.—The annual convention of the American Society of Mechanical Engineers will be held in the Engineering Societies building, 29 West 39th street, New York, December 1 to 4, 1914. The railroad session will be held on Wednesday afternoon, December 2, when the report of the sub-committee will be presented and thrown open for discussion. The subject is Steam Locomotives of Today and it is hoped that the paper prepared by the committee will be the means of bringing out a lively discussion. This paper is printed in full elsewhere in this issue.

The June Conventions.—At a meeting of the executive committees of the American Railway Master Mechanics' Association, the Master Car Builders' Association and the Railway Supply Manufacturers' Association, held at the Hotel Biltmore, New York, on October 22, it was decided to hold the 1915 convention at Atlantic City, N. J. The cities of Washington, Chicago, San Francisco and Atlantic City were under consideration for next year's meeting, and the decision was made only after much discussion and on a very close vote. It is announced that the convention hall will be further enlarged about one-third for the meetings and that the entertainment features will be about the same as in 1914. Headquarters, as before, will be at the Marlborough Blenheim.

The following list gives names of secretaries, dates of next or regular meetings, and places of meeting of mechanical associations.

Air Brake Association.—F. M. Nellis, 53 State St., Boston, Mass. Convention, May 5-7, 1915, Hotel Sherman, Chicago.

American Railway Master Mechanics' Association.—J. W. Taylor, Karpen building, Chicago. Convention, June, 1915, Atlantic City, N. J.

American Railway Tool Foremen's Association.—Owen D. Kinsey, Illinois Central, Chicago. Convention, July, 1915, Chicago.

American Society for Testing Materials.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

American Society of Mechanical Engineers.—Calvin W. Rice, 29 W. Thirty-ninth street, New York. Convention, December 1-4, 1914, New York.

Car Foremen's Association of Chicago.—Aaron Kline, 841 North Fiftieth Court, Chicago; 2d Monday in month, except July and August, Lytton building, Chicago.

Chief Interchange Car Inspectors' and Car Foremen's Association.—S. Skidmore, 946 Richmond street, Cincinnati, Ohio.

International Railway Fuel Association.—C. G. Hall, 922 McCormick building, Chicago. Convention, May 17-20, 1915, Chicago.

International Railway General Foremen's Association.—William Hall, 914 W. Broadway, Winona, Minn. Convention, July, 1915.

International Railroad Master Blacksmiths' Association.—A. L. Woodworth, Lima, Ohio.

Master Boiler Makers' Association.—Harry D. Vought, 95 Liberty street, New York.

Master Car Builders' Association.—J. W. Taylor, Karpen building, Chicago. Convention, June, 1915, Atlantic City, N. J.

Master Car and Locomotive Painters' Assoc. of U. S. and Canada.—A. P. Dane, B. & M., Reading, Mass.

Niagara Frontier Car Men's Association.—E. Frankenberger, 623 Brisbane building, Buffalo, N. Y. Meetings monthly.

Railway Storekeepers' Association.—J. P. Murphy, Box C, Collinwood, Ohio. Convention, May 17-19, 1915, Hotel Sherman, Chicago.

Traveling Engineers' Association.—W. O. Thompson, N. Y. C. & H. R., East Buffalo, N. Y.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Nov. 10	Characteristics of Materials	E. B. Tilt	James Powell	Room 13, Windsor Hotel, Montreal.
Central	Nov. 13	Painting Locomotives and Steel Cars	M. L. Sims	H. D. Vought	95 Liberty St., New York City.
New England	Nov. 10	Typical Rail Failures	F. A. Weymouth	Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Nov. 20	Parcels Post and Its Effect on Railway Revenues	V. J. Bradley	H. D. Vought	95 Liberty St., New York City.
Pittsburgh	Nov. 27	Rolled Steel Pistons	W. W. Scott	J. B. Anderson	207 Penn. Station, Pittsburgh, Pa.
Richmond	Nov. 9	The Average Man in Railroad Work	Odell S. Smith	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Nov. 13	Railway Pensions	J. B. Brittian	B. W. Frauenthal	Union Station, St. Louis, Mo.
Southern & S'w'rn	Nov. 19			A. J. Merrill	218 Grant Bldg., Atlanta, Ga.
Western	Nov. 17			Jos. W. Taylor	1112 Karpen Bldg., Chicago, Ill.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

JOSEPH BILLINGHAM, whose appointment as superintendent of motive power of the Grand Trunk Pacific, with headquarters at Transcona, Man., has already been announced in these columns, began railway work as machinist apprentice on the Great Northern Railway of England, and subsequently was a machinist in the shops of the Chicago & North Western. He served later as a locomotive engineer and road foreman of engines on the Chicago, Milwaukee & St. Paul. In December, 1890, he was appointed road foreman of engines of the Gulf, Colorado & Santa Fe. He was subsequently master mechanic and general master mechanic on the same road, and division master mechanic on the Baltimore & Ohio. In January, 1904, he was appointed representative of the Galena Signal Oil Company at London, Eng., and at the time of his recent appointment as superintendent of motive power of the Grand Trunk Pacific, was general inspector of the American Locomotive Company at Schenectady, N. Y.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

G. F. BURGESS, formerly road foreman of engines of the Canadian Pacific at McLeod, Alta., and later acting district master mechanic at Cranbrook, B. C., during the absence of G. Glasford on leave, has been appointed road foreman of engines at Medicine Hat, Alta., succeeding E. J. Lemieux.

T. C. HUDSON, whose appointment as division master mechanic of the Canadian Northern, Quebec Grand division, has been announced in these columns, was born February 20, 1873, at Brockville, Ont. He was educated in the public schools of Brockville and Carleton Place, Ont., and also studied with the International Correspondence Schools. He completed his apprenticeship as machinist with the Canadian Pacific at Carleton Place, Ont., in January, 1892, since which he has been consecutively machinist at that point, at Chapleau, Ont., and again at Carleton Place. From September, 1901, to April, 1903, he was chargeman in the running shed of the Canadian Pacific at Smiths Falls, Ont., and from April, 1903, to November, 1904, he was chargeman in the erecting shop at Carleton Place. From November, 1904, to January, 1906, he was foreman of the erecting shop at Carleton Place, and from January, 1906, to December, 1906, was locomotive foreman of the same road at Ottawa, Ont. From January, 1907, to August, 1907, he was foreman of the Canadian Northern Ontario at Parry Sound, and from August, 1907, to May, 1908, he held the position of master mechanic of the Canadian Northern Quebec at Shawinigan Junction, Que. From May, 1908, to June, 1914, he was master mechanic of that road and also the Quebec & Lake St. John. On June 23, 1914, he was appointed division master mechanic of the Quebec Grand division of the Canadian Northern, Lines East of Ottawa, as above noted.

T. C. Hudson

J. R. DONNELLY, master mechanic of the Northern division of the Grand Trunk at Allandale, Ont., has been appointed assistant master mechanic of the Ontario lines, with headquarters at Allandale and the title of master mechanic of the Northern division has been abolished.

HARRY M. MUCHMORE has been appointed division foreman of the Atchison, Topeka & Santa Fe at Deming, N. M., succeeding L. Stowell.

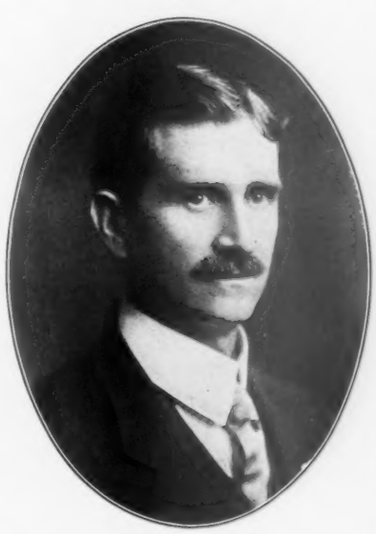
E. J. LEMIEUX, formerly road foreman of engines of the Canadian Pacific at Medicine Hat, Alta., has been appointed district master mechanic at Lethbridge, Alta.

J. MARKEY, master mechanic of the Middle division of the Grand Trunk at Toronto, Ont., has been appointed master mechanic of the Ontario lines, with headquarters at Toronto.

T. MCHATTIE, master mechanic of the Eastern division of the Grand Trunk at Montreal, Que., has been appointed master mechanic of the Eastern lines, with headquarters at Montreal.

W. H. SAMPLE, master mechanic of the Grand Trunk at Ottawa, Ont., has been appointed master mechanic of the Western lines, with headquarters at Battle Creek, Mich., succeeding G. Vliet, deceased, and the title of master mechanic of the Ottawa division has been abolished.

W. H. SNYDER, whose appointment as master mechanic of the Erie with headquarters at Stroudsburg, Pa., has been announced in these columns, was born on July 14, 1874, at Ashley, Luzerne County, Pa. He began railway work on March 18, 1894, as machinist apprentice in the Central of New Jersey shops at Ashley, remaining with that road until July, 1901, when he went to Stroudsburg as a machinist in the Erie shops. In October, 1903, he was promoted to tool room foreman, and in November, 1905, was appointed assistant to general foreman. He remained in that position until January, 1912, when he was promoted to general foreman which position he held at the time of his appointment on September 1, as master mechanic of the same road as above noted. He was the successful contributor in several competitions conducted by the Railway Age Gazette.



W. H. Snyder.

J. H. WOOD has been appointed supervisor of locomotive operation of the Oklahoma and Panhandle divisions of the Rock Island Lines, with headquarters at El Reno, Okla., succeeding C. S. Yeaton, transferred.

C. S. YEATON, supervisor of locomotive operation of the Chicago, Rock Island & Pacific at El Reno, Okla., has been appointed road foreman of equipment at that place, succeeding O. F. Covalt, assigned to other duties.

CAR DEPARTMENT

WILLIAM R. MCMUNN has been appointed general car inspector of the New York Central & Hudson River, with headquarters at Albany, N. Y., succeeding F. W. Chaffee, deceased.

O. E. SHAW has been appointed general car foreman of the Chicago & Eastern Illinois at Danville, Ill. He started railroad work in 1901 with the Merchant's Dispatch Transportation Company at East Rochester, N. Y. From 1901 to 1909 he was engaged as a car builder in a number of shops and on all classes of freight car work. In 1909 he entered the service of the Atchison, Topeka & Santa Fe as an inspector at Cleburne, Tex., and was later appointed assistant car foreman at that point. In April, 1913, he entered the service of the Chicago & Eastern Illinois as car foreman at Villa Grove, Ill., and during the same year was transferred to the Oaklawn shop at Danville, Ill., as car foreman, the position which he held at the time of his appointment as general car foreman as above noted.

SHOP AND ENGINE HOUSE

J. L. CONNORS has been appointed roundhouse foreman of the Erie at Ferrona, Pa.

J. E. DAVIDSON has been appointed night roundhouse foreman of the Erie at Cleveland, Ohio.

R. GARDNER has been appointed locomotive foreman of the Grand Trunk at Island Pond, Vt.

J. F. GREEN has been appointed night roundhouse foreman of the Rock Island Lines at Rock Island, Ill., succeeding H. Krabbenhoft.

W. E. HAYWARD, formerly roundhouse foreman of the Canadian Pacific at Vancouver, B. C., has been appointed night roundhouse foreman at Alyth, Calgary, Alta.

FRANK MAHER has been appointed roundhouse foreman of the Rock Island Lines at Biddle, Ark., succeeding L. Cooke.

T. MCCUE has been appointed roundhouse foreman of the Erie at Cleveland, Ohio, succeeding F. D. McCullough, resigned.

PURCHASING AND STOREKEEPING

S. H. ROBSON, supply agent of the Northern Pacific at South Tacoma, Wash., has been appointed assistant general storekeeper at that place.

O. C. WAKEFIELD, supply agent of the Northern Pacific at St. Paul, Minn., has been appointed general storekeeper, in charge of materials and supplies, with headquarters at St. Paul.

C. B. WILLIAMS, whose appointment as purchasing agent of the Central of New Jersey, with headquarters at New York City, has been announced in these columns, was born on March 22, 1873, at Beech Creek, Pa., and after leaving the common schools was a student at the Pennsylvania State College for a short time. In 1890, he was graduated from Eastman Business College and in July of the following year began railway work with the Beech Creek Railroad, now a part of the Pennsylvania division of the New York Central & Hudson River. He entered the service of the Central of New Jersey on November 27, 1893, as stenographer and chief clerk to the general superintendent. From February, 1900, until September, 1908, he was chief clerk to the superintendent of motive power and then was appointed general storekeeper, which position he held at the time of his recent appointment as purchasing agent of the same road, as above noted.

I. C. C. APPOINTMENTS

A. J. CUNNINGHAM, general foreman of the Atchison, Topeka & Santa Fe at Barstow, Cal., has been appointed inspector of motive power for the Pacific district, division of valuation, Interstate Commerce Commission, with headquarters at San Francisco, Cal.

W. J. THOMAS has been appointed inspector of car equipment for the Pacific district, division of valuation, Interstate Commerce Commission, with headquarters at San Francisco, Cal. Mr. Thomas recently has been employed in the United States Interior Department, and formerly was in railway service.

OBITUARY

CHARLES J. DRURY, master mechanic of the St. Louis & San Francisco at Sapulpa, Okla., died on September 30, at the age of 36. He was born at Chicago Junction, Ohio, and began railway work in July, 1895, as machinist apprentice for the Atchison, Topeka & Santa Fe. After completing his apprenticeship in July, 1899, he was employed as machinist for that road, the Southern Pacific, the Kansas City Southern, the El Paso & Southwestern, the Chicago, Rock Island & Pacific and other roads for seven years, becoming roundhouse foreman for the Santa Fe at La Junta, Colo., in July, 1906. He remained with the Santa Fe until February, 1913, filling the positions of general foreman at Albuquerque, N. M.; bonus supervisor of the Western Grand division; master mechanic of the Oklahoma division at Arkansas City, Kan., and master mechanic of the Plains division at Amarillo, Tex. He then became master mechanic of the St. Louis & San Francisco at Ft. Smith, Ark., and the following February was appointed superintendent of shops at Springfield, Mo. Mr. Drury was promoted to division master mechanic at Sapulpa, Okla., on September 1, just prior to his illness of typhoid fever, from which he died on September 30. Mr. Drury's father, M. J. Drury, is superintendent of shops of the Santa Fe at Topeka, Kan.

E. B. GILBERT, formerly superintendent of motive power of the Bessemer & Lake Erie, died at his home in Greenville, Pa., on September 7. Mr. Gilbert was born at Windsor, N. Y., on December 13, 1843. He took up the trade of machinist, and later was employed on the Erie Railroad, both at Youngstown, Ohio, and at Galion, in the latter place holding the position of foreman. He went to Greenville about 28 years ago, and entered the service of the Pittsburg, Shenango & Lake Erie, now the Bessemer & Lake Erie. He was promoted from machinist foreman to master mechanic, and later to superintendent of motive power, which position he held until his resignation in 1909.

J. P. MCCUEN, formerly superintendent of motive power of the Queen & Crescent Route, died at his home in Avondale, Cincinnati, O., on October 2, aged 70 years. He was connected with the mechanical department of that system for 30 years, retiring about three years ago.

NEW SHOPS

ATLANTIC COAST LINE.—Work is now under way, it is said, on the foundations for an addition to the machine shops at Waycross, Ga.

LOUISVILLE & NASHVILLE.—A building permit has been issued to the Louisville & Nashville for the construction of a 12-stall roundhouse and repair shops in the yard at Lexington, Ky., and work on these improvements is now under way.

AUTOMATIC COUPLERS IN EUROPE.—As far back as 1896, the introduction of automatic couplings was demanded on humanitarian grounds by medical men. Laws were passed in the United States making the adoption of automatic couplings compulsory; and quite recently a similar law has been passed in the Argentine Republic. It is proposed to do the same thing in Brazil. In Europe, the International Union for the legal protection of workmen passed a resolution in favor of the introduction of automatic couplings at its 1908 meeting in Lausanne. Mr. Millerand, the French minister of works and railways, endorsed this resolution in his capacity of president of the French section of the union. The technical committee of the German Verein strongly recommended, in 1900, the introduction of automatic couplings, and expressed the opinion that the technical and economic difficulties were by no means insuperable.—*Bulletin of the International Railway Congress.*

SUPPLY TRADE NOTES

Spencer Van Cleve, president of the Erie Foundry Company, died on September 29.

T. B. Van Dorn, first vice-president of the Van Dorn Iron Works Company, Cleveland, Ohio, has been elected president of the company, succeeding his father, J. H. Van Dorn, who died recently.

Charles Hyland, for many years foreman boilermaker in the Jackson, Mich., shops of the Michigan Central, has resigned to accept the position of boiler expert with the Flannery Bolt Company, Pittsburgh, Pa., succeeding Tom R. Davis, deceased.

The Monarch Steel Castings Company, Detroit, Mich., announces the opening of an exhibit of Lion and Monarch couplers, Lion coupler pockets for locomotives and Lion cast steel yokes in the office of H. F. Wardwell, their Chicago representative at 548 Railway Exchange, Chicago.

At the annual meeting of the American Locomotive Company in New York on October 20, retiring directors W. H. Marshall, A. H. Wiggin and A. W. Mellon were re-elected to serve for three years. The present officers of the company were likewise re-elected to serve for the following year.

The Q & C Company, New York, has taken over the exclusive license and control of the Ross-Schofield system of water circulation for locomotive boilers for the United States and Canada. C. F. Pierce, who had charge of this work with the Ross-Schofield Company, has gone to the Q & C Company as special representative.

The Independent Pneumatic Tool Company, Chicago, has appointed V. F. Robinson its representative in Michigan, with headquarters at Detroit. F. J. Passino, the former representative in Michigan, has been appointed representative in the southwest to succeed H. F. Finney, promoted to a position in the general sales office at Chicago.

The Buda Company, Chicago, Ill., has taken over the repair link for wrecking chains patented by John E. Buckley, former foreman blacksmith of the Illinois Central. This link is of special advantage in wrecking equipment where chains are often broken, and has been used on the Illinois Central for some time. Tensile tests have shown it to be stronger than the other links of the chain to which it is attached. This device is illustrated in the 1912 edition of the Car Builders' Dictionary on page 881.

John Steele Patterson, for the past 24 years resident manager of the Galena Signal Oil Company, Franklin, Pa., at Cincinnati, Ohio, died at his home in that city on October 13. Mr. Patterson was born in Baltimore, Md., on February 13, 1839. He served his term as machinist's apprentice in the shops of the Baltimore & Ohio at Cumberland, Md., and was later general foreman in the Baltimore & Ohio shops at Portsmouth, Ohio. When he was 24 years of age he was appointed master mechanic of the Cincinnati, Indianapolis, St. Louis & Chicago, now the Big Four, at Cincinnati, and served in that position for 25 years. For the past 24 years he had been connected with the Galena Signal Oil Company as noted above.

Ellis F. Muther, eastern sales manager of the Gisholt Machine Company, Madison, Wis., with headquarters in New York, has been appointed general sales manager of the company, with office at Madison. It is also announced that J. E. Brandt, hitherto representative in Philadelphia and vicinity, has become associated with the Swind Machinery Company, which has been appointed a Gisholt agency in that city. J. L. Osgood has been appointed exclusive agent in Buffalo and Rochester, N. Y. R. D. Heflin, formerly representative of the company in New England, has been placed in charge of the New York office, and will henceforth attend to the interests of Gisholt customers and users in the entire eastern territory.

Charles Moulton Gould, vice-president and treasurer of the Gould Coupler Company and the Gould Storage Battery Company, New York, died at his home at Bayside, Long Island on October 20. Mr. Gould has been associated with the Gould Coupler Company for many years. He was born in Buffalo, N. Y., on September 7, 1873, and received his education in the public schools of that city and in De Veaux College at Niagara Falls. In 1895, shortly after graduation, he entered the plant of the Gould Coupler Company at Depew, N. Y., founded by his father, Charles A. Gould, now the company's president. He served in the works for several years and had a large share in their development and the town of Depew which grew up around them, finally going to the New York office as vice-president and treasurer, as noted above. Mr. Gould was very much interested in yachting, and was a prominent member of the New York Yacht Club and the Manhasset Bay Yacht Club.

Tom R. Davis, mechanical expert of the Flannery Bolt Company, Pittsburgh, Pa., died at his home in Dravosburg, Pa., on October 12, 1914, after a long illness. Mr. Davis was born in Allegheny City, Pa., on July 13, 1854. He was educated in the public schools and began work in 1872 as a machinist apprentice in the shops of the Allegheny Locomotive Works (now the Pittsburgh plant of the American Locomotive Company). In 1875 he became a fireman on the Pittsburgh, Fort Wayne & Chicago and in the following year passed his examination for engineer. In 1877 he became a special salesman for the Crosby Steam Gage & Valve Company, Boston, Mass., but left in 1880 to accept the managership of the Monongahela Mfg. Company at Monongahela City, Pa. In 1883 he returned to the Crosby Steam Gage & Valve Company and remained in its employ until 1893 when he became associated with the Garlock Packing Company at Pittsburgh as special agent. In 1898 he entered the employ of the Homestead Valve Mfg. Company, leaving that company in June, 1904, to become mechanical expert of the Flannery Bolt Company, which position he occupied at the time of his death.

Henry H. Westinghouse, brother of the late George Westinghouse, was elected president of the Westinghouse Air Brake Company at the annual meeting on October 15. Mr. Westinghouse has been associated with the company for over 40 years. He was born at Central Bridge, Schoharie county, N. Y., on November 16, 1853. He received his early education at Union High School, Schenectady, graduating in 1870. In 1871 he entered Cornell University to take up the study of mechanical engineering. In 1872 he went to Pittsburgh and became identified with the business of the Westinghouse Air Brake Company. He worked successively in the foundry, machine shop and drafting room, and occupied the positions of general agent, general manager, vice-president and acting president. He was also one of the founders of the firm of Westinghouse Church Kerr & Company, and for many years was the guiding spirit in its management. Mr. Westinghouse is a man of quiet tastes and unostentatious manner. He is a member of the Grolier, Century, Engineers' and Cornell clubs of New York, and the American Society of Mechanical Engineers.

H. H. Westinghouse

CATALOGS

Conduit Boxes.—Pamphlet No. 442, recently issued by the Sprague Electric Works, 527-531 West Thirty-fourth street, New York, is devoted to the line of conduit boxes, outlet, switch boxes and fittings furnished by this company. It is in catalog form and contains 40 pages of specifications and price lists.

Jacks.—Bulletin No. 177 of the Buda Company, Chicago, is a four page pamphlet devoted to mine jacks manufactured by this company. The pamphlet contains price lists and illustrations of the various parts of these jacks, which are of more substantial construction than the usual jacks of similar type and capacity.

Power Plant Instruments.—A 32 page pamphlet has recently been issued by Lewis M. Ellison, 6238 Princeton avenue, Chicago, which is devoted to power plant instruments, including a line of differential draft gages, gas pressure gages and fittings. The Ellison throttling-evaporating calorimeter is also described.

Rust Resisting Iron.—A 32 page booklet recently issued by the American Rolling Mill Company, Middletown, Ohio, contains facsimile copies of letters received from large numbers of users of Armco-American ingot iron showing the high esteem in which the corrosion resisting qualities of this material are held.

Portable Floor Crane.—The Canton Foundry & Machine Company, Canton, Ohio, has recently issued a leaflet briefly describing the No. 4½ Canton back geared portable floor crane and hoist. This crane is designed to lift loads up to 6,000 lb., the back gear being provided to enable one man to lift such loads without assistance.

Mine Hoist Equipment.—The General Electric Company, Schenectady, N. Y., has just issued bulletin No. 48014, which deals with mine hoist equipment. It treats of the general subject of underground hoists, their operation and control, taking up the question of economy of electric drives. It contains 32 pages and is profusely illustrated.

Overhead Tramrail Equipment.—The Whiting Foundry Equipment Company, Harvey, Ill., has just issued catalog No. 111, which is devoted to overhead tramrail equipment. This catalog contains descriptions of a number of monorail trolleys and hand operated hoists especially adapted to foundry use. Copies may be obtained free upon request.

Pneumatic Drills.—A 36 page catalog dealing with the "Little David" pneumatic drill has been issued by the Ingersoll-Rand Company of 11 Broadway, New York. This catalog, which is known as Form No. 8207, contains a description of the construction and operation of the drill, as well as specifications and illustrations of the various sizes manufactured.

Pneumatic Hammers.—The Ingersoll-Rand Company, 11 Broadway, New York, has recently issued a 12 page pamphlet designated as form No. 8013, which is devoted to the "Little David" pneumatic chipping, calking and scaling hammers. It contains illustrations and specifications of hammers for various purposes, as well as sectional drawings showing the mechanism of the hammers.

Pneumatic Tools.—Bulletin 18-A of the Monarch Pneumatic Tool Company, Railway Exchange building, St. Louis, Mo., is a four page leaflet devoted to illustrated descriptions of the Monarch line of pneumatic tools. Tables are given for the various classes of equipment which show the weight, capacity, size of hose connection and other information of value in ordering tools for various classes of work.

Portable Hoists.—Form No. 4033, recently issued by the Ingersoll-Rand Company, 11 Broadway, New York, is an eight page pamphlet devoted to the "Little Tugger" hoist. This is a portable pneumatic hoist specially adapted to use in mines, but which will find a wide application on construction work, in manufacturing plants and around shops wherever a supply of compressed air is available.

Direct Current Test Meter.—Bulletin No. 46390, just issued by the General Electric Company, Schenectady, N. Y., describes a Thomson direct current test meter recently developed by this company. The meter which is known as type CB-5 is designed to eliminate the loss of time in changing standards to cover a wide range of load by combining in one standard several capacities covering a range from light to full load.

Face Hardened Sprocket Wheels.—Catalog No. 50 of the Lehigh Car, Wheel & Axle Works, Catasauqua, Pa., is devoted to the line of chilled charcoal iron products of this company. The larger part of the catalog deals with face hardened sprocket wheels, the price list of a large variety of which is given. Other sections are devoted to cement mill and crushing machinery parts. The catalog contains 64 pages and is well illustrated.

Monorail Cranes.—Bulletin No. 48,700, issued by the Sprague Electric Works, 527-531 West Thirty-fourth street, New York, is devoted to the Sprague line of Monorail cranes. Aside from descriptions of the cranes which are given in considerable detail it contains drawings showing the clearance dimensions and tables giving ratings and weights of the various types of equipment. A number of illustrations showing installations now in operation are included.

Electric Drills.—A folder has recently been issued by the Van Dorn Electric Tool Company, Cleveland, Ohio, dealing with the portable electric drills manufactured by this company. This folder contains a phantom drawing showing the internal construction of the drill and gives a brief statement of some of the advantages of electricity over compressed air. As set forth in the folder many of these drills were used in construction work on the Panama Canal.

Insulating Brick.—The Armstrong Cork & Insulating Company, Pittsburgh, Pa., has recently issued a booklet dealing with the application of Nonpareil insulating brick to boiler settings. The booklet, which contains a number of illustrations, describes the material from which the brick is made, and explains the methods of application. Several photographs are reproduced showing boiler installations which are insulated with this brick.

Stokers.—A 32 page booklet has been issued by the Sanford Riley Stoker Company, Ltd., Worcester, Mass., describing the Riley self dumping underfeed stoker. This stoker is of the inclined undefeed type, differing from other underfeed stokers, in that inclined movable grates are substituted for the ordinary type of dead plates. The booklet is well illustrated, photographs of a number of installations being shown in addition to details of the apparatus.

Air Compressors for Foundry Use.—Bulletin No. 42,800, recently issued by the General Electric Company, Schenectady, N. Y., contains a reprint of an article appearing in the General Electric Review relative to the use of electrically driven air compressors in foundries. The article compares centrifugal compressors with fan blowers and positive type blowers showing the superior features of the centrifugal compressor for this class of service.

Electric Railway Data.—In Railway Exchange Data No. 10 the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has brought together considerable data pertaining to the operation of street railways, as well as a number of practical suggestions of value in the operation of electric railway equipment. Among the subjects treated are: Improvement of voltage on interurban lines; Effect of voltage on performance of motors; Cost of stops and trailer operation and Train operation in city and interurban service. The pamphlet contains 32 pages, and is illustrated with a number of curves and drawings